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METHODS OF MEASURING MUSCULAR TENSION

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INTRODUCTION

The term "muscular tension" is not one which is clearly defined in terms of physiological mechanism. As the titles in the appended references show, usage of the term as a designation for a class of phenomena is characteristic of much psychological work but very rare in physiology. "Tonus," on the other hand, is a concept which is used in both sciences, and in physiology has been the basis of a considerable body of literature.

In psychology an investigation of muscular tension might begin by deciding upon a particular physiological process and devising methods which would measure that particular process; on the other hand, the investigation might begin by selecting a technique giving promise of revealing some psychological relationships and proceed with an operationally defined concept. In either case, a consideration of physiological mechanisms would be requisite; in the former case at the outset, and in the latter case at the stage of interpretation and correlation of results obtained by different methods.

The first characteristic of muscle—physiological, or, perhaps better, physical, which has sometimes been designated as tonus—is its intrinsic physical properties regardless of innervation. Pollock (56) suggested the importance of tension (in the sense of pull) elasticity, extensibility, resilience, plasticity, and hardness as being related to "tone," and Pollock and Davis (57) analyzed tonus in terms of viscosity and elasticity. Aside from the effect of humoral factors (which has been demonstrated), tonus in this sense would be expected to be practically a constant and not of great psychological interest. It is clear, however, that such physical characteristics of a muscle may be altered by the operation of neural mechanisms, and the measurements of these definite physical properties may be carried out during the operation of the neural mechanisms.

This was actually done by Pollock and Davis and by Fenn and Garvey (**22**), and McKinley and Berkwitz (**48**) were led to a study of the effects of neural arcs because of the variable results they obtained in trying to measure the physical properties of muscles in the intact organism. Results under these conditions would be expected to exhibit more relationships of psychological importance.

The nature of the neural mechanisms influencing muscle tonus has been the subject of most physiological investigations of the subject. From at least the time of Johannes Müller until recent years it has been customary to distinguish between tonic and phasic muscular activity. The phasic response was described as sudden in onset and greater in intensity, while the tonic response was slower, relatively nonfatigable, and present to some degree in normal muscles at all times. There have been various attempts to distinguish separate mechanisms for the two sorts of response. In the muscle itself, red components were assigned the role of tonic response and white components that of phasic, but the work of Denny-Brown (**18**) shows that such a dichotomy cannot be maintained. As to the neural mechanism, Hunt (**34**) urged that tonic and phasic contractions are one aspect of a general duality of function of the nervous system. A number of writers, *e.g.* Langelaan (**41**), have thought that the sympathetic fibers which are known to enter skeletal muscles are responsible for the tonic state; and one, Ken Kuré (**40**), has postulated a parasympathetic innervation in addition. The study by Denny-Brown has shown the suppositions of direct sympathetic influence on tonus to be incorrect.

As a result of the investigations of the English school of physiologists, of Magnus (**45**) and his associates, and of electromyographic studies such as those of Fulton and Liddell (**27**) and Bergami and Miserocchi (**2**), it now seems clear that there are not two different mechanisms of neuromuscular action: there are, rather, gradations in the degree of activity of a single mechanism. Discussion of this question and exposition of the general theory of tonus as postural reflex are given in Cobb and Wolf (**10**), Sherrington (**61**), Denny-Brown (**18**), and more in detail in Wachholder (**66**, **67**) and Bremer (**6**). These accounts are all in substantial agreement that so-called tonic contraction results from a combination of reflexes not strongly excited and discharges from the higher centers, differing only quantitatively from phasic movements. At the lowest reflex level is the myotatic or stretch reflex thought to be spinally controlled for the most part. The tendon reflexes are the

rapid operation of this sort of response. The stimulus operating is the stretch of a muscle, generally an extensor, and the response is a shortening or an increase in pull of the extensor; and, as indicated by electrical records (Mies, **50**; McKinley and Berkwitz, **47**; Wachholder, **66**), usually a similar, though lesser, activity in the flexor antagonist. Superimposed on the myotatic reflexes and combined with them in result are the reflexes of Magnus, and still further adding to the complexity, "the influence of higher centers" which, however, has been but little studied by the physiologists.

In view of this account, Cobb and Wolf propose that the term "tonus" as applied to skeletal muscle be abandoned. Possibly the term "tension," suggesting no distinction between mechanisms, is a better usage. One might then set out to measure tension as a property of the muscle itself, or as a property of the muscle produced by its neural stimulation, as a combination of the two, or as the resultant of the action of groups of muscles.

A great deal of psychological work on the relationships of tension depends on the experimental inductions of varying degrees of tension. An increase in tension beyond that normally occurring is readily produced by forcing the subject to work against a spring or against gravity. A lowering of tension is less easily accomplished, though instructions are sometimes effective, especially with experienced or trained subjects. The production of an artificial tension level without distraction and disturbance of the process being studied is quite difficult. Nevertheless, results of studies of this kind are of considerable interest, especially when they can be related to the effects of normally occurring tensions. For this purpose it is essential that the size and location of tension induced by the experimental device be known. In other words, we return to the problem of the measurement of whatever tensions are present for whatever reason.

For the many kinds of apparatus used to measure tension it is important to determine which sort of tension each measures in order that the results may be compared. Devices may be classified into six major groups: (1) those applying external forces mechanically and recording resistance to movement offered by limb or muscle, (2) those recording slight movements of parts of the body, (3) those eliciting reflex responses, (4) those requiring the subject to perform some voluntary response, (5) those recording electrical properties of the skin, and (6) those recording the electrical properties of muscles.

Modes of Measurement

The Application of External Forces

Devices of this character have been described by McKinley and Berkwitz (**47**), Fenn and Garvey (**22**), Schaltenbrand (**60**), Conen and Tönnies (**11**), and Paskind (**55**). They have been rather widely used for the study of physiological problems and for psychological problems by Paskind, Henley (**31**), and Hollingworth (**33**). In the earlier forms of the apparatus a falling weight was made to move a pivoted rod, and acceleration of the rod's movement with and without a subject's arm or leg attached to it were measured and compared. The braking effect of the limb was taken as an index of muscular tension. In an improved form of the apparatus the applied force is developed by a motor and coupled to the limb by means of a coiled spring, the extension of which indicates the resistance to movement offered by the arm.

Freeman's (**24**) method of tendon deformation may be regarded as a refinement of this procedure. A standard weight is caused to rest on the patellar tendon of the subject, thus exerting a pull on the muscles to which it is attached. If the muscle exerts a strong counterpull, the tendon will be depressed but little. Hence, the amount of depression, multiplied by an optical lever, is taken as an index of muscular tension.

These methods, of course, do not differentiate primarily between the physical characteristics of muscle and its reaction to neural stimulation. Where movement of limbs is permitted, it is also clear that the tension measure obtained is not the absolute tension of any one muscle or muscle group but the algebraic sum of the tensions of the antagonist, or rather some function of such a sum. In the final analysis, these methods may be classified as reflex methods and subject to the same considerations as the other reflex methods, since the application of stretching force to an extensor (and possibly to a flexor) is the adequate stimulus for a myotatic reflex. The tension measured is therefore in part actually one generated by the test force; and it is only the readiness of the muscle to generate this tension which is of psychological interest.

The applied force technique has some disadvantages for psychological purposes. One is the necessity of keeping the subject in a fixed position. More important, perhaps, is the distracting nature of the measurement. It is probable that a subject will be stimulated to make some voluntary or automatic response to the working of the apparatus. Such effects have been noted in some of the

physiological studies, and were encountered by Henley when he found that subject objected to a passive flexion movement which was too wide in extent.

The Recording of Movements

Devices for the recording of movement or "pressure" are commonly known, and their general principles are discussed by Wendt (**68**). Either pneumatic, mechanical, or, conceivably, optical recording may be used. Studies of tension have been carried out by this method in the investigations of Golla (**29**), Golla and Antonovitch (**30**), Jacobson (**36**), Luria (**44**), Allport and Vernon (**1**), Williams (**71**), and others. In certain of these investigations (**30, 36**) an apparatus was designed to allow movement as freely as possible. In others, intentionally or otherwise, the apparatus, such as pneumatic bulb or tambour, offers considerable resistance to movement. The devices may be said to tend to record isotonic and isometric contractions. In none, however, is movement really eliminated or reduced to a minimum, and the "isotonic" method, therefore, seems easier to interpret.

In this sort of recording, likewise, the measurement made represents the action of both flexors and extensors. Theoretically there could be a high state of tension, equal in both, which would be recorded as zero. A decrease in pressure on a bulb, for example, has sometimes erroneously been presumed to indicate necessarily a decrease in muscular activity. It might equally well signify a movement of extension (Clites, **9**). In fact, lacking other data, one must take movement simply as movement, for it is impossible to translate it into tension in any narrower sense.

Theoretically, direct measurement of the thickening of single muscles, sometimes used in movement studies (*e.g.*, Dodge and Bott, **19**), would be a desirable method. Freeman (**24**), however, reports the method insufficiently sensitive and discriminating for the purpose.

Reflex Recording Devices

It may be said that the use of reflexes for the study of muscular tension is a secondary method, depending as it does upon a preestablished correlation between the size or frequency of the response with muscular tension measured in some other way. Tendon reflexes, eyelid reflexes, and response to electric shock have been studied as measures of tension by Lombard (**42**), Golla and Antonovitch (**30**), Clites (**9**), Tuttle (**65**), Jacobson (**37**), Miller

(51), and Courts (12). An account of reflex recording apparatus is given by Wendt (68).

It has long been known that there is some relationship between the prior neuromuscular activity of the individual and the size and threshold of reflexes. It was Jendrassik's observation on the facilitation of the knee-jerk by a hand-clasp which evidently influenced Lombard to investigate environmental determinants of the reflex. Jacobson (37) reviewed the literature of the physiological mechanism involved. Studies comparing independent measures of reflex and tension are not so very common. Golla and Antonovitch found a close correspondence between tension, as indicated by limb position (extension) and size of tendon reflex. Hoffman (32) found that flexor tension (voluntarily induced) in the leg decreased the tendon reflex, while extensor tension increased it. Jacobson reports a result which he interprets as indicating decrease of the knee-jerk with general relaxation. Although no separate measure of relaxation was taken, indirect evidence makes the interpretation seem likely. Courts found a close relationship between pressure on a hand dynamometer and size of knee-jerk. Betchov (4) presented evidence, based on palpation methods in pathological cases, that the tension-reflex relation does not always obtain. Sleep and relaxation are known to reduce or abolish tendon reflexes (Jacobson). It is, of course, a common clinical observation that patients who are quite tense generally fail to show a knee-jerk. It is possible that the reflex in such cases is present but masked; yet ordinary methods of detection of the reflex would be expected to yield a nonlinear relation between tension and reflex, with the maximum at medium tension.

It should be observed that studies of the effect of tension upon reflexes are not precisely the sort of investigations that would be most useful in answering our question. It would be more to the point if the problem were stated the other way round: "What does reflex size signify regarding tension?" In other words, it is conceivable that a heightened reflex might be produced by tension and also by other factors than tension. However, it is legitimate to conclude that, other things being equal, reflex magnitude is an indication of tension in normal subjects, though the sense of the word tension and the location of the state are not clear.

Stimulation of reflexes like the tendon jerks is in itself distracting and tension-producing, and for this reason is often inappropriate for use in psychological experiments.

The Performance of Voluntary Acts

The manner in which a subject performs an act which he is instructed to perform may be used as an index of muscular tension. The basis of the index may be correlational, as in the use of the ergograph, or direct, as in the measurement of grip pressure or force of movement during the performance of a motor task. A variety of rather standard apparatus is available for this sort of measurement, and the same considerations apply as for the measurement of involuntary movements.

Luria (**44**) has urged that more significant results are obtained if the movement measured is an integral part of the response being studied; that it would be better, for example, to study grip pressure in a hand that is required by the situation to move than to investigate grip pressure during a verbal response. Both types of study might be of interest. A number of investigators have followed Luria's recommendation in this matter (Duffy, **21**; Allport and Vernon, **1**; Ghiselli, **26**; Stroud, **64**; Ford, **23**; Runkel, **59**). In a way, Morgan (**53**) may be said to have anticipated the method, without Luria's theoretical background, when he measured key pressure while the subject was working a typewriter under several experimental conditions.

Electrical Properties of the Skin as Indices of Tension

It has been suggested by a number of recent studies that the electrical resistance of the skin or a measure derived from it may serve as a convenient measure of muscular tension. According to the view of Sidis (**62**), now known to be erroneous, all psychogalvanic phenomena originate in muscles and hence would be an index of muscular action. The current proposal has quite another basis: that of a correlation empirically established between the two variables, and a theoretical analysis showing their ultimate common origin.

The technique for measuring the skin resistance or conductance is the same as that for measuring the changes in these, known as galvanic reflexes, except that the measuring instrument need not have such a short time constant. It should be noted that there are a number of methods for making these measurements (see, for example, Darrow, **13**; Richter, **58**; Davis, **15**) which, though equally valid, do not necessarily yield comparable absolute values, and that there are a number of factors which may operate to invalidate a set of results, factors which would be immaterial in the

measurement of a "pure resistance" like a stick of carbon or a length of wire. It may be remarked that an investigator would be ill-advised to proceed with an experiment until he is reasonably sure his instrument meets the necessary qualifications. It would be premature to set forth detailed specification of apparatus at this time, inasmuch as the American Psychological Association has recently appointed a committee to make recommendations on the standardization of such devices.

The experimental work of White (**70**), Wenger and Irwin (**69**), and Freeman and Simpson (**25**) on the correlation of skin resistance and muscular tension all shows the same trend. In each experiment three levels of tension were induced in the subjects, and resistance was found to vary inversely with tension. Darrow (**14**) pointed out that skin conductance shows certain effects of body posture, changes in situations producing the grasping reflex, and is controlled by the same brain area as the grasping reflex, and proposed the interpretation that skin conductance change is accessory to postural mechanisms. These considerations indicate an important connection, but so far as the present evidence goes, the statement of Wenger and Irwin, that "no unqualified relationship can be claimed," is correct. It has been shown that induced tension produced variations in resistance, but the evidence does not show that there are no other conditions which will produce such changes. Interesting for its own sake, skin resistance can be taken as an indication of muscular tension only with much caution.

Electrical Properties of Muscles

Several electrical properties of muscle itself have been used as indices of its tension. In at least one instance (Monnier and Sigwald, **52**), measurements of chronaxy have been taken as indicative of tension. Primarily, of course, a chronaxy is a constant of excitability and so represents muscular tension only in so far as it can be shown to correlate with that variable. Indicative of such a correlation is the finding of Lapicque and his associates, that muscle chronaxy changes under the influence of innervation, and perhaps the general doctrine, previously discussed, that excitability in tendon reflexes is influenced by a state of tension. So far as the writer is aware, however, it has not been demonstrated that a change in chronaxy always signifies a change in muscular tension. Without confirming evidence it would be safer, therefore, to speak of chronaxy measurements as signifying simply state of excitability.

A little-developed method of some promise is the measurement of the electrical resistance of muscles themselves. This method was used by Buchtal (7, 8), Bozler (5), and Dubuisson (20) in physiological studies. As Buchtal pointed out, the general account of bioelectric phenomena as given by Gildemeister and Osterhout would lead one to expect a decrease in the resistance of an excited muscle. In fact, this should be the regular accompaniment of the action potential. Buchtal found a decrease of 30% in resistance when a muscle was stimulated to contraction. His method was to measure the "current of rest" from the muscle and compute therefrom the internal resistance. Bozler imposed an alternating current on the muscle and reported a slight increase in resistance. This method might have the advantage of requiring a less sensitive device than the measurement of potential. Needle electrodes could be used, to avoid skin effects, or the skin reflexes could be avoided, as they are in potential work, by using a recording instrument which will reject such slow phenomena as originate in the skin.

By far the most widely used electrical technique is the recording of action potentials from muscles. These may be regarded as direct indications of the tension of muscles in one sense of that word. The indication given is one of muscular activity, and with a suitable disposition of apparatus the activity of single muscles, or parts of muscles, can be recorded. Although the recording of action potentials during muscular movement has been ordinary practice for the past 30 years, the first use of the method for the study of tensions in psychological situations was that of Golla (29). This investigator used in some of his studies a direct measurement of muscle thickening with pneumatic tambours. Perhaps because of the technical difficulties involved in such a procedure, he used the string galvanometer for a study of preparatory adjustments. Electrical work with the lesser tensions began with Jacobson's use of an amplifier to measure the sensitivity of the recording system. Because of its importance the technique merits discussion in some detail.

Amplifiers. It is, of course, the possibility of amplification that enables one to study the small potentials of the tension states. If it is desired to study steady or slowly changing potentials, a direct coupled amplifier would be necessary (with needle electrodes to eliminate phenomena originating in the skin). Although apparatus of this kind is available, little use has been made of it for the study of muscle tension because of the centering of interest on muscular

contractions, which seem to produce momentary spikes rather than steady potentials. The possibility of steady potentials should not be dismissed, however, since they do seem to occur in the orbital muscles of the eye.

For the recording of spike potentials, amplifiers with resistance-condenser or transformer coupling are best suited, the resistance-condenser type being preferable, since it is ordinarily less likely to produce distortion. Certainly it is preferable not to have the subject connected to the amplifier through a transformer ("low impedance input") even at the sacrifice of some convenience, for the effect of the transformer will depend on the variable impedance of the subject, and the over-all gain of the amplifier will be, therefore, impossible to specify. The gain of the amplifier should be enough so that voltages of one microvolt may be recorded, if it is desired to study minimal tension. The necessary over-all gain of the amplifier would depend on the kind of recording instrument used; for the cathode-ray oscilloscope it would be of the order of 10,000,000. Such a gain will ordinarily require four stages of amplification with high-gain tubes. Frequency response of the amplifier, to be sure to avoid rejecting any muscle potentials, should be linear between, roughly, 20 and 400 cycles per second. To secure this linearity, large coupling condensers are required (0.5 or 1.0 mfd.).

Care must be taken to prevent feed-back and resulting oscillation. Separate shield boxes for each stage are required. A convenient scheme is to mount each tube horizontally, with its grid connection in one box and others in another. A heavy choke in the voltage supply circuit by-passed to the ground will increase stability, and by-passed resisters in the screen and plate circuits of each stage are desirable. Stages constructed on the push-pull plan have the advantage of greater stability when their use does not introduce additional complications (see below). The high-frequency noise level of the amplifier can be reduced by shunting a condenser of a few thousandths of a microfarad across the output.

It is desirable to include in the amplifier some means of controlling the gain by known amounts. This can be done by using variable grid leaks in one or two stages. For checking the gain and frequency of the amplifier, an audio-oscillator is coupled to a voltage divider (the General Radio Microvolter is most convenient), and the known output fed into the amplifier.

Possibly a suitable amplifier could be constructed to work entirely with rectified AC for supply voltages, but the task would be difficult and probably not worth the trouble for research purposes. The difficulty, of course, is that of getting rid entirely of voltage fluctuations.

Ordinarily, commercial radio parts are adequate for use in such an amplifier, and the construction is not particularly complicated A competent radio technician should be able to construct one for less than $100. The circuit diagram given by Davis (**17**) may be taken as one illustration of the principles recommended.

Recording Device. Basically, the recording instrument may be any device which will respond to the potentials being investigated without distorting them through its inertia, or which will summate them in some known fashion. Some types of magnetic "ink writer" may meet the criterion of linear response over the necessary frequency range, though their characteristics should be tested before reliance is placed upon them. Another type of device which has been suggested is an oscillograph depending on the electrical properties of a crystal (Musgrave and Metfessel, **54**). The chief drawback to this device is that room temperature may become high enough to affect the crystals. The most reliable oscillographs are the moving coil and cathode ray. Both have response characteristics quite adequate for the purpose. Both record photographically without particular difficulty. The cathode-ray instrument has the advantages of being much cheaper (the elaborate secondary circuits offered by the manufacturers are usually of little importance for the psychological laboratory), of being more versatile and more rugged, and of offering visibility during photographic recording. It can be viewed and photographed in an electrically lighted room. The moving-coil oscillograph has the advantage that it can more easily be arranged for multiple recording.

Where exact timing of phenomena is not essential, and where there is some certainty that artifacts are not being recorded, a summating device may be used. For this purpose the output of the amplifier is rectified by the use of a tube operating as a detector, and the rectified current is fed into an accumulating device. This may be a long-period galvanometer which maintains a deflection proportional to the sum of potentials occurring during its period (Jacobson, **38**); or it may be a condenser so arranged as to build up a charge during a definite interval, whereupon it is discharged and the accumulation measured (Jacobson, **39**). Time required to

accumulate a fixed charge may also be measured (Freeman and Hoffman, 26). The use of the condenser as an accumulator is difficult because of the extreme precautions which must be taken to prevent leakage through the dielectric and through the atmosphere.

Shielding and Grounding. The setting up of the recording equipment usually requires considerable trail-and-error procedure to discover the optimum shielding and grounding arrangements, and during operation a certain amount of vigilance may be necessary to secure best results, particularly if the location is subject to electrical disturbances from the outside.

If transformers are avoided in the construction of the amplifier, the only shielding necessary is electrostatic. Magnetic disturbances produce little effect. Since the subject is connected to the input, he should also be included in the shielding (if a high impedance input is used, as seems desirable) or some special circuit device used to eliminate extraneous potentials. A cubicle of wire screening serves very well to shield the subject, though sheet metal is a little more effective. Leads from the subject to the amplifier should be as short as possible, with shielding for both, unless one is a ground.

The whole system will ordinarily require careful grounding. In a circuit diagram there are obviously many points indicated as electrically equivalent to the one marked for grounding. In working with high gains these points are nevertheless not really equivalent, as may readily be seen if one accidentally or intentionally grounds two of them at once. This will almost surely introduce a high-level 60-cycle voltage into the amplifier. Evidently one cannot neglect the impedances of connecting wires and metal plates in such a circuit. The particular point which produces the best grounding will probably depend on local conditions and must be determined by experiment. Presence of 60-cycle voltage while the subject is connected, with absence of the disturbance when the input is open, probably indicates grounding trouble rather than poor shielding.

Multiple Recording. Simultaneous recording from more than one body location introduces certain problems beyond the duplication of apparatus. For many purposes tensions in different parts can be compared quite well by using one recording channel, or two amplifiers and one oscillograph, if a switching device is provided. A number of electrodes can be connected to the subject and con-

nected to the recording system alternately by a manual switch (useful records cannot be taken for a few seconds after manipulation of the switch, because of overloading), or an electronic switch can be used between amplifier and oscillograph (Loucks, **43**) or possibly ahead of the amplifier. When separate channels are used, oscillation or "cross talk" through common batteries or stray capacity coupling must be avoided by complete separation of the circuits, and preferably by some distance between them.

In multiple recording one may take advantage of the push-pull circuit if the recording device does not require that one side be grounded. As ordinarily used, the cathode-ray oscillograph must be grounded, and an attempt to couple two channels to such devices by means of transformers will result in oscillation when both inputs are connected to the same *S*. Mathews (**46**) proposed a circuit for the multiple recording of electroencephalograms (where the same problems occur). Mathews thought that a first amplifier stage, constructed on the push-pull plan, with the center point five megohms above ground, could be fed into a single-sided, grounded amplifier and remain independent of other similar circuits. Circuit analysis and experimental test proves, however, that such circuits lack independence.

Electrodes. The electrodes used for recording tension by this method need not be elaborate. Since the current flow through them is negligible (with high impedance input, at least) and since the potentials recorded are momentary rather than steady, polarization of electrodes is of no importance. In his early work, Jacobson (**35**) devised an elaborate scheme to control the temperature of the electrodes so as to avoid thermo-electric effects. Rough calculation of these from the coefficients in the International Critical Tables shows that they could hardly be large enough to affect a record. In any case, they would be expected to be rather steady potentials and therefore eliminated in the amplifier. Needle electrodes, simple, concentric, or in shielded pairs, or small plate electrodes on the surface are commonly used. The introduction of a needle, is of course, likely to disturb the ordinary subject and invalidate the record, and the following considerations indicate that the surface electrode can be made to accomplish as good results. The surface electrode, of course, must be held in place firmly. Electrode paste is helpful in reducing contact resistance.

Choice of electrode location and interpretation of results is sometimes influenced by a false assumption regarding the electrical

properties of the subject's body. It is a mistake to suppose that electrodes will simply pick up any potential which originates between them, and attempts to control the selection of potentials by placing electrodes near together or far apart are therefore not necessarily effective. Clearly, the body is a "volume conductor" through which potentials originating anywhere establish fields in all directions, and any electrode will fundamentally assume the potential of the point at which it is located, while the amplifier will transmit the difference between the two that are attached to it. Principles governing the distribution of fields in a conductor have been applied to the case of the electrocardiogram by Wilson (**72**) and his associates and, following their lead, by Davis (**16**) to the case of the muscle action potential. These analyses are confirmed by a device which may be used to test many electrode properties. A potential is introduced into a pan of fluid conductor (tap water is convenient) by electrodes a standard distance apart. The area or volume of the conductor is then explored by the electrodes of a vacuum tube voltmeter. A similar experiment, with confirmatory results, can be performed on a subject by introducing a test wave at some location and exploring with the electrodes of the action potential recording instrument. Theoretical analysis and experiment show that the gradient surrounding a wave is rather steep, that only extremely large waves will be recorded at all at a distance of one or two centimeters from an electrode.

The so-called bipolar lead, composed of similar electrodes, generally, close together, will therefore record the potential difference between two points, both affected by a field arising from the same bioelectric effect. It would seem advantageous to avoid letting the same field influence both electrodes (in so far as possible). This can be done by treating one electrode as a "neutral" and taking advantage of the sharp downward gradient of the field as one recedes from the source of the phenomenon. A large thick pad placed over the skin, with the electrode attached to the outside, may be expected to attenuate whatever action potentials arrive beneath it, so that the records obtained may be interpreted as arising from the active electrode exclusively. This neutral electrode may be placed anywhere, but for added safety it is well to place it in some part, if there is one, which is expected to be rather inactive.

Another consideration will also influence the placement of the neutral electrode. The tremendously strong field produced by the action potential of the heart permeates the body. Points which are

equidistant electrically from the source and in the same direction are, however, isoelectric with respect to the heart potential. All points on each arm and on both legs are, for example, isoelectric with one another, or very nearly so. If, therefore, one wishes to eliminate the cardiogram from the record of muscle potentials, the neutral electrode may be placed on a point which is isoelectric with the active electrode.

In multiple recording the same plan may be followed, with, naturally, but one ground electrode. In general it is impossible, then, to place the neutral electrode so as to avoid the cardiogram on more than one recording system. There has been some success reported in using push-pull amplifiers with the first stage isolated from the ground in such a way that the several systems are independent and do not record the cardiogram.

While somewhat elaborate, the technique of recording muscle action potentials seems important. It is clear, from the foregoing discussion, that none of the other techniques (with the exception of the undeveloped muscle resistance method) measure the same physiological function as this, and it is, of course, unlikely that any of the measures depending on a pre-established correlation would represent the variable quite as well as a direct measure. Interpretation of tension measures in psychological experiments, therefore, needs to take account of the differences in kinds of tension indicated by the several measures, which are not readily translated one to the other. The action potential method has definiteness, uniqueness, sensitivity, and produces a minimum of distraction; its psychological significance depends, of course, on the experimental establishment of relationship to psychological conditions.

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RELATIONS BETWEEN MUSCULAR TENSION AND PERFORMANCE

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The present review is concerned with two general topics: the influence of experimentally induced muscular tension on performance, and the changes in muscular tension which accompany various performances. No attempt will be made to include the results of clinical studies of neuromuscular hypertension or of those dealing with the various phenomena subsumed under the somewhat ambiguous term "psychical tension." Studies to be mentioned here are for the most part those which have appeared since 1936, although in some instances earlier references are cited.[1]

The Influence of Experimentally Induced Muscular Tension on Performance

Following the pioneer investigation by Bills (1) a number of investigators, utilizing a variety of techniques for inducing tension and a variety of performances to be executed under the additional experimental tension, attempted to test his general conclusion that experimentally induced tension facilitates mental work. The findings were as varied as the experimental procedures used, some experimenters reporting facilitation of mental work, some inhibition, and some observing no appreciable influence. The salutary result of such diversity in data was to focus experimental attention towards the problem of defining the conditions which modify the influence of tension on performance.

Amount of Induced Tension

Following the suggestion implicit in the work of Freeman (**33**), showing that extreme degrees of tension interfere with certain performances, and that of Jacobson (**54**), in which it was found that mental activity is difficult, if not impossible, under extreme relaxation, Stauffacher (**75**) demonstrated that there is an optimal level of tension induced by squeezing dynamometer handles under which serial memorization of nonsense syllables is most efficient. Tensions below and above the optimum resulted in less facilitation. This finding was corroborated by Courts (**16**), who also

[1] Bibliographical sources are listed at the end of this review.

showed that tensions higher than those used by Stauffacher resulted in memorization below the normal level of efficiency. Freeman (**35**) has further substantiated the finding that there is an optimal level of tension for a given performance. Bykow, *et al.* (**8**) have investigated conditioned salivary responses in dogs after having the animals pull a cart containing various weights. As the amount of work was increased, the previously established CR became stronger up to a certain point beyond which further increases in work served to inhibit the response. A possible interpretation of the results is in terms of the differential amounts of residual tension resulting from the work period. That such residual tension will affect subsequent work in ergography with human subjects has been shown by Sharp (**70**). In a recent investigation Courts (**18**) has found that, during the early stages of practice on the Koerth pursuit-rotor, the relationship between amount of tension and level of performance is essentially the same as that between tension and memorization. The inverted U-shaped curve appears to be typical of the relationship between learning and degree of experimentally induced tension.

In performances which involve little or no learning, the form of the relationship of efficiency to level of tension is not so clear. Freeman (**35**) has found the U-shaped curve to hold in the case of finger oscillation under tension. Other investigators have found an approximately linear increase in level of performance with increases in tension in the case of the knee-jerk (**15**) and vibratory sensitivity (**14**). Freeman (**35**) states that increments in tension were found to disturb mental arithmetic, although his data were not presented in the published report. Courts (**17**) has failed to find an appreciable modification of the latency and amplitude of the eyelid reflex to a puff of air as a result of various degrees of tension induced by squeezing a hand dynamometer. Peak (**66**) has suggested, however, that the stimulus may have been of such intensity as to elicit a maximal response, which would make further facilitation difficult, if not impossible.

It is of interest to note here that the inverted U-shaped curve is found also in situations where strength of incentive has been systematically varied. One of the earliest studies was that of Yerkes and Dodson (**79**), in which it was found that an electric shock of medium intensity made for fewer errors in learning than did weaker or stronger shocks. In a more recent experiment Finan and Taylor (**28**) found that equated groups of rats deprived

of foods for intervals of 1, 12, 24, and 48 hours showed differences in conditioning strength in the Skinner apparatus when conditioning strength was measured in terms of extinction. The optimal deprivation interval was 12 hours. Conditioning strength was less for intervals shorter and longer than the optimal. The authors suggest on the basis of variability data that drives stronger than the optimal may impair conditioning through decreasing the variability of response. An investigation by Bunch, Frerichs, and Licklider (**7**) resulted in the finding that rats subjected to 16 hours of enforced wakefulness required fewer trials to learn a multiple-T water maze than did rats who were allowed a normal amount of sleep or those who were kept awake for 8, 24, and 48 hours. Time scores showed no significant differences among the groups. Error scores were larger for the 24-hour and 48-hour groups than for the control, 8-hour, and 16-hour groups. The similarity of these findings to the results of experiments dealing directly with different degrees of experimentally induced muscle tension suggests the importance of proprioceptive factors in motivation (**27**).

Locus of the Induced Tension

It has been shown by Freeman (**33**, **34**) that different tension loads may affect optimal facilitation of a given performance when acting within different muscle groups. He concludes that optimal facilitation is obtained when the tension is in muscle groups most closely related neurologically to the reacting member. It is interesting here to note that facilitation of the knee-jerk of the right leg is essentially the same when tension is induced by squeezing a dynamometer with either hand (**15**).

Since most of the investigations dealing with experimentally induced tension have produced the tension by having the subjects exert effort against weights or springs with either the arm or leg muscles, it would be enlightening to have data on the effect of tension induced in various other musculatures. Comparison of the work of different experimenters, however, who have used different procedures for producing tension is abortive, since other factors have not been comparable in the experimental situations. It is to be desired that future research will produce data on the facilitation and inhibition of performance as a function of the relationship between the pattern and locus of muscular activity involved in the performance and the pattern and locus of the additional experimentally produced tension. This may be accomplished

through a refinement of the available techniques for recording muscle action potentials.

The Observed Performance

Any discussion of the influence of tension on various types of performances must be limited by the fact that studies involving different performances differ with respect to the locus and amount of tension used. Moreover, as has been shown by Freeman (**33, 35**), the optimal tension is not the same for all performances. Consequently, neither the observed effect nor the absence of effect resulting from tension can be generalized to situations differing from those in which the observation was originally made. Performances which have been found to show facilitation under tension are memorization (**1, 16, 75**), pursuit learning (**18**), reaction time (**33, 43**), latent time of blocking of the alpha rhythm (**57**), finger oscillation (**34, 35**), adding columns of digits (**1**), letter-naming (**1**), tapping (**5**), conditioning salivary response in dogs (**8**), maze learning (**9**), vibratory threshold (**14**), startle response (**53**), threshold for electric shock (**33, 62**), and knee-jerk (**15**). Detrimental effects have been noted in the case of mirror star-tracing (**35**), mental arithmetic (**35**), tossing tennis balls at a target (**68**), and postural steadiness (**69, 73, 74**). Other investigations have reported an absence of effect in continuous addition, syllogistic reasoning and selection of analogies (**4**), affective judgments (**10**), and the eyelid reflex (**17**). Future investigations should study the influence on these performances of various degrees of tension induced in different musculatures.

It has been suggested (**35**) that the influence of experimentally induced tension may vary with the complexity of the task, simple tasks being facilitated more than complex ones. Although the experimental findings listed in the above paragraph fail to show any clear relationship of this kind, they do not disprove the alleged relationship, since the available data have been obtained under widely different tension-producing conditions. One difficulty which must be surmounted in testing such an hypothesis is that of defining complexity. Obviously this should not be done in terms of the influence of muscular tension.

Another relationship, proposed by Bills and Stauffacher (**3**), is that of the effect of tension as a function of the difficulty of task, tension facilitating easy performances more readily than difficult ones. Difficulty is more readily defined than is complexity. How-

ever, the data necessary to prove or disprove the influence of task difficulty were not presented by the authors.

Practice Effects

(a) *Practice in Working Under Tension.* In his original investigation Bills (1) observed that the increased efficiency of performance under tension was enhanced with practice and fatigue where speed of performance was the criterion. Where the length of trials was determined by a time limit rather than a work limit, however, practice was observed to have no effect on the amount of facilitation resulting from tension. In view of the fact that facilitation of tension effects with practice occurred only in those experiments where a work limit was used, Bills' results may be attributed to some characteristic of the work-limit situation. It appears possible that, as work progressed, the subjects became increasingly aware of the fact that rapid work would secure earlier release from the experiment. Thus, practice may have resulted in a shift in motivation without influencing the effect of tension in itself.

(b) *Practice in the Performance to be Executed Under Tension.* Another aspect of the problem of practice effects is suggested by Stauffacher's (**75**) finding that poor learners who had no previous practice in memorization of nonsense syllables by the ancitipation method showed greater benefit in this performance as a result of tension than did practiced poor performers. This was not stated as a conclusive result, and subsequent research has not been directed towards its corroboration or disproof.

(c) *Practice in Executing a Given Performance Under Tension.* A third problem in the relation of tension effects to practice is that of determining the relative levels of performance at successive stages of learning when tension has been experimentally induced throughout learning. In a study of pursuit learning under tension Courts (**18**) has shown that the optimal tension becomes smaller and that the detrimental effects of above-optimal tensions become more severe and occur earlier in the tension series as learning progresses. These changes, however, may represent cumulative work decrement rather than a persisting modification of the effect of tension.

Before any conclusion can be drawn concerning the influence of practice on tension effects it will be necessary to investigate thoroughly these three problems.

Volitional and Motivational Factors

Evidence was presented above in the discussion of practice effects that volitional and motivational factors may play an important part in producing the effects attributed to tension. Bills' (1) data show, however, that the amount of facilitation at the beginning of the experiment when scores were in terms of time—a situation presumably favoring the operation of extraneous motivational factors—was essentially the same as that produced by tension when a work limit was used. It was only after the subject had opportunity to learn that faster work would win earlier release from the experiment that tension in the work-limit situation became more facilitative. This would indicate that tension *per se* exerts a facilitative effect apart from the volitional and motivational factors which might operate in a given experimental situation. The same argument applies to the results of Bills' experiments on addition and letter-naming. Bills (81) has called attention to the possible existence of two kinds of tension: that due to emotional upset, and that which reflects effort. The former is inhibitive of performance, the latter facilitative. More recently Courts (18) has suggested that the modification in successive trials of a learning task of the relationship of performance to amount of experimentally induced tension may be the result of an accumulation of emotional disruption. Nevertheless, however, important volitional and motivational factors may be, tension alone appears to influence the level of performance. Sharp (70) has shown that output in ergographic work is facilitated by residual tension in the resting, but previously reacting, arm following a period of similar work. Since it is unlikely that the volitional and motivational factors (compensatory effort in order to overcome the 'distraction' of the tension-producing situation) mentioned by Block (4) in her criticism of Bills' findings were acting in Sharp's experiment, his results may be taken as evidence of the facilitative action of tension *per se*.

Individual Differences

Most investigations dealing with the influence of experimentally induced tension have called attention to wide individual differences in the kind and amount of effect resulting from tension. It is commonly observed that most subjects show facilitation of performance under an optimal degree of tension (3, 4, 75). Some, however, show disruption accompanying any experimentally in-

creased tension. Bills and Stauffacher (3) and Stauffacher (75) have asserted, without presenting statistical proof, that poor performers are more apt to benefit from experimentally induced tension than are good ones, the latter being adversely affected. In attempting to test Bills' and Stauffacher's statement Courts (16) found that, although good memorizers benefited less from tension than did poor ones, the differences were slight and statistically insignificant. In comparing gains of good and poor performers it is necessary that the scores represent comparable units of increment or decrement at the two levels of performance being compared. Since their statement concerning the effect of tension for good and poor performers was based on the comparison of raw scores, there is some doubt concerning the real meaning of Bills' and Stauffacher's results.

Stauffacher (75) has advanced an ingenious hypothesis to explain the alleged differential effect of tension for good and poor performers in terms of the level of tension ordinarily present during work. According to this hypothesis, since poor performers habitually maintain a level of tension below the optimum, any additional experimentally induced tension brings the total tension nearer the optimum. Similarly, since good performers are already at or near the optimal level, additional tension makes for a total tension which is less facilitative than the level which they normally maintain during work. In an attempted test of this hypothesis, comparison of subjects who showed slight increase in tension during memorization (measured in terms of amplitude of knee-jerk) with those who showed great increases has failed to show any appreciable differences in the influence of tension experimentally induced by squeezing a dynamometer (16). Probably the pattern and locus of originally maintained and experimentally induced tension, and the relationships between the two tensions, are as important as the "normal" level of tension in determining individual differences in tension effects. This problem may be solved through the application of refined techniques for measuring muscle action potentials.

In addition to the pattern and amount of tension normally maintained by the subject, individual differences in susceptibility to the emotionally disruptive factors accompanying the experimental induction of tension are undoubtedly of considerable importance in determining individual differences in the effect of such tension.

Hypotheses Concerning the Effects of Induced Tension

In discussing Bills' original results, Robinson (67) suggested three possible explanations of the influence of dynamometer tension. These were: (1) Dynamometer tension may bring about greater constancy of proprioceptive stimulation, which, in turn, may act as a stabilizer in holding constant extraneous stimuli; (2) the increased proprioceptive stimulation may have brought about a general increase in tension with a resulting readiness to react in all muscle groups; (3) the increased proprioceptive stimulation raises the general level of excitement in the cortex, increasing the speed and accuracy of operation even of its more complex response patterns. The first of these suggestions could easily be tested experimentally. Although the implication of the second hypothesis, that tension spreads to other musculatures than those directly involved in grasping the dynamometer, has been substantiated by subsequent research, the question of how such generalized tension operates to facilitate performance still remains unanswered. Experimental test of the third hypothesis would require more refined measures of cortical activity than are now available.

Freeman (32) had previously proposed the hypothesis that afferent stimulation of the cortex set up and maintained largely by muscular tension lowers the threshold of excitability in the higher nervous centers. It was further postulated that the thresholds for various levels of functional activity are not the same. Moreover, he assumed that muscular contraction above a certain point becomes an inhibitor of precise neural integration. The mechanism by means of which inhibition is brought about is not clear.

The fact that the level of performance decreases with tensions above the optimum is not easily explained at the present time. It may be that the amount of psychological activity increases with any increase in induced tension, but that beyond an optimal tension that activity interferes with the aspects of performance which the experimenter is measuring. The regular incrrease in the amplitude of the knee-jerk with increments in induced tension (15) offers some basis for such a point of view.

In learning situations, where the inverted U-shaped curve has been shown to hold for a number of performances executed under induced tension, it may be that increases in tension influence learning efficiency through increasing variablity. If there is an optimal variability of response for a given performance, efficiency would

be below maximum with variabilities above and below this point. Fortunately, it would not be difficult to measure the influence of induced tension on variability of response.

Changes in Muscular Tension Accompanying Performance

The variety of recording techniques used in studies of muscular tension and the consequent lack of an operational definition of the concept of tension militate against generalizations concerning the tension accompaniments of performance. Nevertheless, since the relative advantages and disadvantages of the available methods for measuring muscular tension are discussed by Dr. Davis in the first section of this review, the present treatment will merely call attention to the methods used in obtaining the results cited without attempting to evaluate the adequacy of those methods.

Tension Accompanying Continuous Work

It is generally agreed that continuous mental or muscular work is accompanied by an increase in muscular tension as measured in various ways over the level maintained during rest (**23**, **31**, **48**, **61**, **78**). Only rarely are individuals found who show no change or a decrement from their resting tension when work is introduced (**22**, **51**). At the onset of work there is an initial increase in tension which rapidly drops down to a level somewhat above that of the rest condition (**23**). There is some evidence that the height of the initial rise is a function of the subject's set (**44**, **78**). Following this "initial spurt" tension gradually increases as work continues (**2**, **21**, **22**, **23**), perhaps retarding through proprioceptive reinforcement the rapidity of work decrement.

A number of attempts have been made to demonstrate correlation between level of performance and muscular tension. White (**78**) found that superior performers tend to show higher skin resistance during code learning than do poor performers. The difference, however, was slight. Clites (**12**) observed that successful solution of a water-dipping problem from the Stanford-Binet is accompanied by decreased skin resistance. He further found (**13**) that, during successful work on this problem, muscle action potentials are stronger, overt movements become less, and grip tension decreases (through tense straightening of the fingers) more than during unsuccessful attempts. Duffy (**25**) observed that with children two to four years of age degree of tension as measured by

pressure on hand dynamographs correlated −.47 with tapping and −.48 with a discriminatory response to pictures. Freeman and Giese (41) have shown that, as the difficulty of visual discrimination increases, palmar skin resistance decreases, and Brown's (6) results show a low correlation between skin resistance and the number of trials necessary for learning a list of nonsense syllables. Davis (22) and Hadley (50) have reported an increase in muscle potentials from the forearm and neck and from the forearm, respectively, with increase in difficulty of arithmetical tasks. Davis's results, however, show that such a relationship is true in the case of failure as well as successful solution. Furthermore, Davis (21, 22, 23) finds no evidence for a consistent relationship between output of work and level of muscle action potential. Calling attention to the fact that a peripheral theory of psychological processes demands a correlation between psychological process and muscular phenomena rather than one between work product and muscular phenomena, he suggests:

> In the present state of analysis it may be said that the increase in muscular tension observable during "mental work" may be explained as dependent upon the following conditions: (1) the use of a rest period in which less work is actually performed than during the test period; (2) the amount of practice in the performance tested; (3) the distracting stimuli operating during the test period; (4) the amount of work completed. In summary form the relations may be expressed as follows:
>
> $$\Delta AP = f\left(\text{Work, Distraction, } \frac{1}{\text{Practice}}\right) - f\,(\text{Rest Period})$$
>
> where ΔAP signifies the increase in muscular activity during the work period. It is likely also, though in no wise tested, that the second term should have a distraction and practice term similar to that of the first (21, p. 25).

Comparison of action potentials during rest and work in successive experimental sessions shows that the difference in level of activity becomes less with practice (21). This finding is in agreement with the commonly observed changes in overt activity as habituation to the work situation proceeds. Comparison of tensions in different muscle groups shows a shift in the relative levels of activity as work continues (19, 31), tension tending to become more localized in the reacting musculature.

Davis (21) presents evidence concerning the effect of distraction on muscle potentials during and following two minutes of oratorical stimulation while the subjects were attempting to read

a difficult passage with the understanding that they were to be tested at the end of the experiment. Action potentials were found to increase regularly during the period of work under distraction. It is not known how long the increase would continue if distraction were present for a longer period of time. That the effects of distraction on muscle tension might be dissipated with habituation is suggested by Davis's finding that on successive practice days the difference in action potentials during rest and work becomes less. This expectation is further reinforced by Freeman's (**37**) observation that the magnitude of action potentials is less on successive days of work under noise distraction, and by Davis's (**20**) earlier investigation in which it was shown that skin resistance drops suddenly with the onset of noise and recovers gradually during continuation of that noise for five minutes. These results are similar to Ford's (**29**) observations concerning the degree of "effort" accompanying mental work under alternating periods of quiet and noise.

It may be that any abrupt change in environmental conditions, including such events as transition from normal activity to the experimental situation, will make for a superfluity of muscular activity, which is dissipated with practice. At the beginning of successive periods of similar activity the superfluous muscular tension would be expected to be progressively less.

Frustration

The increased muscular tension which accompanies a novel environmental situation may be considered a symptom of the maladjustment of the organism to the environment. In frustration, where the readjustive response is prevented by the difficulty of the required behavior or by other factors, muscular tension would be expected to persist on a high level longer than it does when readjustment is comparatively more easily attained. Clites (**11, 12, 13**) has observed a decrement in muscular activity, as measured by skin resistance, winking rate, muscle action potentials, and grip tension, following successful problem-solving. Incorrect solutions are also followed by decreased activity, but the decrement is smaller and less reliable than that following correct solutions. Further evidence that successful problem-solution is accompanied by decreased tension has been presented by Grinstead (**49**). On the other hand, Davis's results (**22**) show no statistically significant relationship between the increased action po-

tentials accompanying the solution of number series problems and success or failure in solution. His observations on the influence of practice and distraction (21) apparently reconcile the discrepant observations concerning the correlation between muscle activity during work and work accomplished. It appears, however, that the relationship between muscle activity following the solution of a separate problem within the work period (a single readjustive episode) and the correctness of that solution may be a function of the subject's impression of the adequacy or inadequacy of his response. In other words, the degree of relief experience by the subject is related both to the correctness of his response and to the degree to which he is able to perceive such correctness. Frustration then, results when readjustment from the subject's point of view is not attained and does not necessarily occur whenever the subject fails to give the response required by the experimenter.

In view of this extension of Davis's thesis that a peripheral theory argues "for a correspondence of muscular phenomena with psychological process rather than with product" (21, p. 26), it would seem that the data concerning the relationships of muscle tension to task difficulty or level of performance are not strictly applicable to the problem of muscle activity during frustration. It is true that Davis's data (22) show only a very small and statistically insignificant tendency for action potentials occurring during attempted solution of number series subjectively evaluated as 'failure' to be higher than potentials accompanying subjective 'success' in performance. It was necessary, however, for his subjects to wait until the group of problems (one to five problems) was finished, or until failure was admitted by giving up the task, before they were allowed to write out their obtained answers. It was thus possible that any decrease in action potentials which might have followed subjectively acceptable solutions was obscured by activity accompanying the attempt not to forget the solution during delay of the consummatory response. Moreover, data were not presented for the period immediately following this response, where, it might be expected, the effects of adequate or inadequate readjustment would be most likely to appear.

Jost (56) obtained measures of skin resistance and hand tremor from children who were asked to learn by the anticipation method a list of digits which were too difficult after they had just previously learned two easy lists. Skin resistance decreased with frustration for both normal and maladjusted children, the change being sig-

nificantly greater for the maladjusted group. Hand tremor increased with both groups, with the increase being significantly greater for maladjusted children. Another situation in which the subjects were prevented from making the readjustive response required by the situation has been reported by Freeman (**30**). In this case intentionally produced interruptions of various mental and mental-muscular tasks produced increased tension as measured by tendon deformation.

Freeman (**38**) has recently suggested that many maladjustments of personality may be studied experimentally through observations of muscular tension.

Since individual differences in susceptibility to frustration are a well-known fact, it would be expected that such differences might be correlated with measures of muscle tension. Representative studies dealing with personality differences in relation to muscle tension are those of Freeman and Katzoff (**42**), Jost (**56**), and Wenger (**77**).

Learning

The changes in muscular tension which accompany practice in continuous work have been mentioned above. These changes are probably to be found in learning situations also. Few studies have been directly concerned with observing tension changes during learning. Stroud (**76**), on the basis of pneumatic recording of downward pressure and grip, concluded that tension decreases during the learning of a difficult stylus maze but increases during the learning of a comparatively easy one. Daniel (**19**) observed that a decrease in action potentials during the first trials in learning a stylus maze is followed by an increase up to the cessation of practice. Decreasing tension was found to be associated with the elimination of errors, while increasing tension accompanied increased speed of performance. Daniel suggests that subjects learning Stroud's difficult maze showed a decrease in tension, since there were many errors to be eliminated, while in learning the easy maze the subjects worked for speed and thus showed an increase in tension.

Ghiselli (**46**) found that tension remained at a uniform level while his subjects were learning to press three keys in a predetermined serial order. Time between responses was held constant. Tension, measured by the amount of pressure exerted on the keys, dropped rapidly in trials following mastery of the problem. Vari-

ability in tension, which was observed to be great during the initial trials, rapidly decreased as learning progressed.

The results of these studies would seem to indicate further that readjustive responses are followed by decreased muscular tension. In the case of Stroud's difficult maze, and in the first part of Daniel's maze-learning situation, tension decreased as the subjects, presumably motivated towards eliminating errors, succeeded in attaining their goal. Where the subjects were working for speed, however, there was no definite subjective criterion of the adequacy of their response. Thus, readjustment was not achieved, and muscle tension was observed to increase.

Brown (6) has shown that in anticipation learning of nonsense syllables galvanic deflections accompanying wrong anticipations or absence of response are greater than those accompanying correct anticipations. This offers further evidence that the readjustive response is accompanied by less organic disturbance than is a non-adjustive response.

Sharp (70) has recently observed that action potential output from muscles used in an immediately preceding 2-minute period of ergographic work is cyclical in nature, with maximal tension appearing around 15 minutes after the end of the work period. Freeman and Sharp (45) have demonstrated the cyclical nature of action potentials from the biceps following weight-lifting. These results raise the question as to what are the characteristics of residual tensions in learning experiments. If such tensions are found to follow a cyclical course, they will constitute an important factor in any hypothetical explanation of such phenomena as the relative effectiveness of spaced and massed practice, the influence of presentation interval in memorization, the effect of different intervals between periods of practice in experiments on retroactive inhibition, and, perhaps, reminiscence. In addition to residual tensions, conditioned tensions (implicit and minimal responses) (52) would be important for explaining these phenomena.

Set

The concept of set has suffered from lack of operational definition and from absence of agreement concerning its use (47). Nevertheless, there are certain time-honored experimental situations to which the concept has been applied, such as the measurement of reaction time and psychophysical experiments. Davis (24) has reviewed the literature on muscular tension in the reaction time ex-

periment in his report of an experiment in which action potentials were taken from the forearm during finger reaction to a light. When the light came on, *S* was to get ready to react, and when it went off, he was to move a key to the right as quickly as possible. Two groups of subjects were run, one with regular, and one with irregular foreperiod. The results showed: (1) Muscle tension is greater during the foreperiod than during a rest period. Although it is greater at the end of the foreperiod than at the beginning, the curves which Davis presents suggest that with longer foreperiods muscle tension would return to a level near that at the beginning of the period. (2) Reaction time is inversely related to the level of tension at the end of the foreperiod. When an irregular foreperiod is used, the highest tension and the shortest reaction time occur with a foreperiod of about average length. (3) Tension is higher and reaction time shorter when a fixed rather than a variable foreperiod is used. Since tension during the foreperiod shows changes similar to those attributed to set, Davis concludes that "sets are patterns of incipient muscular and glandular activity" (**24**, p. 29)

Freeman and Kendall (**43**) have presented results which suggest that the optimal foreperiod in the reaction time experiment may vary with the degree of tension previously induced in the reacting musculature They found that a heavy tension load shows a longer optimal foreperiod than does a light tension load Since Davis's results showed a positive relationship between action potentials and speed of reaction, and since the heavy tension load used by Freeman and Kendall would raise the subject's tension to a high level earlier in the foreperiod than would the light load, their finding is not according to expectation Freeman and Kendall however, observed only three subjects under a heavy tension load and six under a light load, so the observed difference may represent a sampling error

Action potentials taken from the forearm of a trained subject during lifting of pairs of weights were found by Payne and Davis (**65**) to be lower for judgments of "heavier" during the foreperiod and during lifting of the standard than they were for judgments of "lighter" Following lifting the variable weight, however, the potentials were higher when the judgment was "heavier" The judgment appeared to be a function of the ratio of action potentials during the variable lift to those during the standard lift. Furthermore, the value of the variable which gave judgment of equality

was approximately the value which gave equality of action potential. The authors conclude that "the close correspondence between properties of muscular action during weight lifting and properties imputed to Einstellung and physiological trace suggests that these concepts may be reformulated into a peripheral theory of the perception of lifted weights" (65, p. 242). Further evidence of the similarity of muscle action potentials and the alleged properties of set and physiological trace is to be found in a paper by Freeman and Sharp (45), in which they report a correspondence between the time-error function in lifted-weight judgments and the course of residual tension in the biceps following lifting a weight of 500 grams through an arc of 60 degrees. Although the similarity of the two functions is marked, any conclusions based on these data must be tentative, since the action potentials were not recorded concomitantly with the determination of the time-error function.

Freeman (36, 43) suggests an hypothesis concerning the interaction of central nervous functions and peripherally initiated activity in determining the behavioral phenomena usually attributed to mental set. In the face of alleged demonstrations of the "central" locus of set (63, 64) he has argued for the importance of differential motor adjustment (40). On the other hand, Davis (24) views set as incipient activity, the actual beginning of the response in the reaction time experiment. Unlike Freeman (36), who believes that there are not enough varieties of muscular tension to take care of all the various manifestations of set, he suggests that, since different activities in their incipient stages may be very similar, there are as many different patterns of tension as there are varieties of set.

The question of the peripheral or central locus of set, however, is outside the scope of the present review. It seems that, rather than attempting to find isolated instances in which differential "sets" (defined according to a particular experimenter's whimsy) are not accompanied by differential patterns of muscular activity, research should be directed towards working out further such relationships as were studied in the experiments on reaction time and weight perception.

Muscular Activity and Subjective Phenomena

The work reviewed above has been concerned entirely with the relationships existing between muscular tension and other

objectively observable behavioral phenomena, and, as Davis (**21**) suggests, there is no insurmountable difficulty in dealing "with a motor theory of psychological process in general, as for instance a motor theory of learning or of memory, without introducing consciousness as a middle term." Such a theory, which does not include consciousness as an intervening variable, Davis designates as a "peripheral theory." Since it is the reviewer's opinion that this point of view offers promise of more fruitful research than does the attempted proof or disproof of the "motor theory of consciousness," little space will be devoted to that theory. Early research has been critically discussed by Max (**59**). The significant aspect of such research is not the fact that negative results have been reported by some investigators, nor is it even the relative frequency of positive and negative findings. It is rather the increasing number of psychological processes which are discovered to be accompanied by muscular activity as techniques and apparatus for observing such activity become more adequate (**26**).

The work of Jacobson (**55**) and of Max (**58, 60, 61**) indicates the importance of muscular activity during mental processes. Their results show that presence or absence and locus of muscular activity is correlated with presence or absence and variation in verbal reports of subjective experience. Shaw (**72**) more recently has shown that vividness of imaginal weight-lifting is related to intensity of action potentials. The lack of consistency among individuals and within the individual with respect to the pattern of muscular activity accompanying a certain verbal report or following a given instruction to the subject has dismayed investigators in this field. Shaw (**71**), however, interprets his data as signifying "that during the revival of vestigial responses one can expect to be present any muscular activity that accompanied the original response." On the basis of this interpretation it would be expected that individual differences in pattern of muscular activity in a given situation might be controlled experimentally through varying responses previously associated with that situation. Similarly, variations within the individual could be investigated as a function of practice under different conditions.

The question as to the temporal sequence or the cause-and-effect relationship between subjective experience and motor phehomena is at the present time outside the realm of experimental attack.

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PSYCHOLOGY AND THE WAR

Edited by

STEUART HENDERSON BRITT

CONTENTS

STATEMENTS FROM THE EMERGENCY COMMITTEE IN PSYCHOLOGY

Statements have been received from the Emergency Committee in Psychology concerning the following three problems:

1. It is the considered judgment of the Emergency Committee in Psychology that at the present time the psychological associations should not request blanket exemption from military service of graduate students in psychology, but should seek to determine the merits of each individual case through the system already established and operating in the National Roster of Scientific and Specialized Personnel, as briefly described in the April issue of the *Psychological Bulletin*. Meanwhile, efforts are being continued to determine the factual status of the demand for psychologists in both the military and nonmilitary aspects of the war effort, in relation to anticipated shortages of such professional personnel.

2. The Emergency Committee wishes to encourage psychologists to continue in fundamental research wherever that is possible without detriment to the war effort.

3. Editors and contributors to psychological journals who may be concerned about the possible need for censorship of any information contemplated for publication should communicate with Dean Luther P. Eisenhart of Princeton University, Chairman of the Advisory Committee on Scientific Publications of the National Research Council.

UTILIZATION OF PSYCHOLOGISTS IN THE UNITED STATES NAVY

BY JOHN G. JENKINS,
Lieutenant Commander A-V(S), USNR

Utilization of psychologists by the U. S. Navy falls under three chief headings:

(1) Construction, administration, and interpretation of psychological tests.

(2) Interviewing, varying from more or less typical pre-employment interviewing through a variety of types to include clinical interviewing in search of signs of psychological abnormality.

(3) Special services, including a wide variety of tasks for which the professional training of the psychologist makes him eligible.

By the time this article appears, 50 psychologists will have been commissioned in the category of Hospital Volunteer Reserve (Special Service), officially labelled as H-V(S). A few additional psychologists are commissioned as Deck Officers, Volunteer Reserve (Special Service), known as D-V(S). At least five others hold commissions for special work in Communications, C-V(X), or in Aviation Volunteer Reserve (Special Service), A-V(S). These men range in rank from Ensign to Lieutenant Commander.

The H-V(S) group is concerned with a program of selecting aviation cadets under the cognizance of the Medical Research Section of the Bureau of Aeronautics. At least one H-V(S) officer is assigned to each Naval Aviation Cadet Selection Board at which volunteers for service as naval aviators originally appear. These men apply psychological tests which are designed to screen off those applicants least resembling previously successful cadets. In most cases they also participate in screening interviews, either alone or in company with Line and Medical officers.

There are at least two psychologists at each of the Induction Centers to which men are sent for ground-training, indoctrination, and physical toughening, after they have been accepted by the Selection Boards. These men administer—but do not report or interpret—other psychological tests, the use of which is described in the next paragraph. They participate in a program of perceptual training which plays an important part at this stage. They are also available for consultation with individual instructors and students as psychological problems arise.

One or more psychologists is assigned to each of the several

Naval Reserve Air Bases to which the cadets go for the first third of their flight training. The duties of these men center about the interpretation of the results of those psychological tests which have been administered previously. According to official directive, low scores on the tests must be taken as cause for "washing out" a cadet, if his early flight performance is not at least average. The tests are thus employed in combination with a work-sample of flight performance. Since they were validated with uncontaminated criterion data on not less than 5000 cadets, it is not surprising that the test program has found hearty support at the hands of Commanding Officers and Medical Officers. Ordinarily the H-V(S) officer sits as a member of the Flight Board which passes on the records of cadets. In addition, he interviews students at specified stages in their training, serves as adviser in cases of behavior difficulties, and usually is attached in some capacity to Ground School. Many of the psychologists at the Bases have found themselves increasingly operating as consultants to instructors and to others concerned with Training.

At least one H-V(S) officer is attached to each of the large Naval Air Stations, to which cadets go for advanced and operational training. Since all commissioned flight personnel in the Navy receives training as pilots, there is no problem of dividing the air crew into bombardiers, navigators and pilots, such as is encountered in the Army Air Forces. At the Naval Air Stations, however, the cadets must be assigned to special types of air operations (e.g., aboard carriers, aboard patrol boats, or in observation scouting) and the psychologist is asked to assist in making these assignments. He also serves in connection with the indoctrination of personnel in the low-pressure chamber, supervises the preparation of reports on attrition, advises with students and instructors, aids in formulating examinations, and participates in research.

This program of selection is coordinated by the writer who is assigned jointly to the Medical Research Section of the Bureau of Aeronautics and to the Bureau of Navigation. He is assisted by other H-V(S) officers who are assigned to the Medical Research Section. These men are responsible for conducting all central analyses of test data, for continued research on the effectiveness of the tests used, and for the central recording of test and criterion data. With the use of automatic equipment, more than 16,000 cadets were represented (as of March, 1942) in the central file. For each of these cadets there were coded punch cards on which were

recorded biographical data, performance data in training and afterward, and a record of all test scores, including those given for research purposes as well as those routinely administered for selection.

Through the generous and far-sighted cooperation of the Civil Aeronautics Administration, the H-V(S) group has maintained an extremely close liaison with the Aircraft Pilots Committee of the National Research Council. Members of this Committee, cleared by the appropriate federal agencies, have been conducting tests in various Naval Stations and Bases for the past two years. Tests developed on civilian personnel have been tried out with thousands of naval cadets. The peacetime policy of the Civil Aeronautics Administration has permitted (encouraged, indeed) in wartime an increasingly responsible role for the Committee in current Naval research. At the time of writing, the Committee is engaged in carrying out several major projects specifically requested by Navy officials, two of them being under the Training Division.

To date this group has tried out more than 45 psychological tests against training-performance. The present battery used by the Navy represents the small number of tests that, in combination, has shown the highest predictive efficiency, when validated on Navy personnel and with Navy training criteria. As rapidly as combat data can be secured—and this cannot be very rapidly—all of the tests will be run against performance under fire. Until then, selection will continue to employ a battery which has shown —in a series of large samples—the highest validity against Navy training criteria, using this prediction in combination with a work sample of early flight performance.

Although the largest group of psychologists is thus concerned with problems of aviation personnel, this is by no means the only assignment for psychologists in the naval organization. The next largest group is located under the jurisdiction of the Bureau of Navigation and has to do with problems of selection and training of the general Navy personnel. As Louttit has pointed out (1) in a recent article, the Navy began experimenting with psychological tests for use in general selection about twenty years ago.

For the last ten years, a battery of five tests, specially designed for use with Navy personnel, has been used under official directives. This work is under the direction of Mr. C. N. Smith, Educational Adviser in the Bureau of Navigation. Psychologists assigned to his division are concerned with the construction, main-

tenance, and analysis of tests which serve as recognized conditions for admission and for advancement of general Navy personnel. They have to do as well with the establishment of curricula for specialized training in the several Naval Training Stations, with the construction of improved achievement examinations, and with problems of improvement of instruction. There is at least one psychologist at each Naval Training Station assigned to this type of work, in addition to those attached to the central office in Arlington. This division calls freely on psychologists as consultants in the construction of tests and in the solution of other problems with which it is faced.

A careful review of the total situation shows that the employment of psychologists does not end with these two groups. A small number of psychologists is engaged in clinical interviewing at Naval Training Stations. Several others are on special assignments which may not be described at this time.

In addition to these official assignments, psychologists within the Navy organization are presented with stimulating opportunities to serve as consultants in meeting psychological problems that arise in the operations of various Divisions and Bureaus. It is not possible to describe these in any detail at this time, but it may be said that problems of selection and training in various naval fields of activity are being referred to available psychologists with increasing frequency. To put the matter in slightly different terms, there are many naval officials of various ranks who recognize that psychologists have methods suitable for the solution of various practical problems and who do not hesitate to act upon this knowledge. It is to be hoped that certain contributions of this sort can be described when the war is over.

Finally it should be reported that psychologists are labelled as psychologists and are not smuggled in under some other professional category. Under the classification H-V(S), for example, there are recognized as 'specialties' the categories PSYCHOLOGIST and PSYCHO-PHYSIOLOGIST. It should also be noted that liaison with flight surgeons, as the writer has previously reported, is generally close and effective. Psychologists have not attempted and are not attempting to invade the field of the flight surgeon; and the flight surgeon has been willing to permit the psychologist to carry out his normal procedures of validation and cross validation of tests with sympathy and insight. Once psychological tests have proved their value in actual trial, it is rare to find a flight surgeon

or a line officer who fails to award them the support they warrant. There is every reason to hope that continued research will establish the use of sound psychological procedures in selection and in training as a genuine and lasting contribution to the war effort.

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SERVICES OF PSYCHOLOGISTS IN THEIR COMMUNITIES

Many psychologists throughout the country are interested in carrying on research projects which will be useful in relation to the war effort. In addition to special research projects, psychologists can also find their professional skills immediately useful in community service, and they can be extremely effective in this connection. A few of the services which can be carried on by psychologists within their communities are:

Assistance of local units of the Office of Civilian Defense in the selection of men and women for special duties, and allocation of all volunteer workers to suitable responsibilities.

Assistance of local units of the Office of Civilian Defense in developing training programs for men and women assigned to special duties, such as aircraft "spotting."

Service on local morale committees.

Work with local defense organizations in developing plans for camouflaging defense plants, communications sections, etc.

Teaching of special defense classes.

Lectures on problems of defense and morale.

Talks to parents and teachers on the impact of war on children, and on the minimizing of the mental disturbances in children produced by war news and by necessary defense measures.

Organization and teaching of training courses for volunteers in child care.

Recording of various kinds of psychological information resulting from war changes.

Assistance in social problems arising in connection with mentally deficient women and girls in neighborhoods of Army camps and in thickly populated industrial areas.

Application of recent experimental findings in leadership training to courses for training of civilian leaders (such as leaders in defense courses, nursery school teachers, air raid wardens, leaders in clubs of all kinds).

Participation in various research projects on food habits. DR. MARGARET MEAD, Executive Secretary of the COMMITTEE ON FOOD HABITS, has asked for the cooperation of psychologists in carrying out some of the projects which the National Research Council Committee is undertaking.

A COURSE IN MILITARY PSYCHOLOGY

BY L. A. PENNINGTON AND H. W. CASE[1]
University of Illinois

The need for practical psychological training in the handling of men in military situations has been increasingly evident since the beginning of the war. This need is further evidenced by reference to reports recently offered by Bingham (2), Louttit (3), Yerkes (4), and others. The survey of the German literature, as summarized by Ansbacher (1), supports these statements. This practical value of psychotechnology has been amply demonstrated by its use in the German army. In the United States, however, there exist few, if any, specifically psychological training programs designed primarily to make available psychotechniques to those college men interested in military careers.[2] That such a program is deemed desirable has been emphasized in the proposal made recently by Yerkes (4). The purpose of this paper is to describe in an introductory and summary way the development of an applied program in psychotechnology useful to those college men who are about to become commissioned officers in the armed forces of the United States. In the following paragraphs we shall present a discussion of a course in Military Psychology as arranged by staff members in the Department of Psychology at the University of Illinois.

The problems of (1) course objectives and (2) mechanical arrangements are of practical concern for those who plan such a program. These considerations pertaining to the Illinois course in Military Psychology[3] have been dealt with in the following ways. First, the primary objective of the course is to facilitate the handling of enlisted men by providing officers-in-training with those

[1] The authors comprise the Co-ordinating Committee in charge of general arrangements for and supervision of the course entitled Military Psychology offered by the Department of Psychology, University of Illinois. One of the functions of this committee is the preparation of this and other reports. The members of the instructional staff include the following: H. B. Carlson, H. W. Case, J. T. Cowles, D. D. Feder, W. M. Gilbert, L. M. Hanks, W. G. McAllister, L. A. Pennington, and P. T. Young.

[2] This statement refers specifically to the training of officers in psychotechniques useful in handling men and not to the equally important problem of training military psychologists, research and personnel technicians.

[3] This course is to be designated as Psychology 50 in the University of Illinois' *Catalogue* and *Time Table* (1942–1943).

psychological techniques useful in military situations. It is conceded that other objectives might have been accepted. Since, however, the fundamental aim of an educational program determines to a large extent the results anticipated, the aim of the present course is believed more pertinent to the present military needs than is any other. Thus, to illustrate, the course might have been designed to provide a cultural program for all college students interested in a study of the psychological basis of war. Indeed, the course might have been, in addition, arranged to facilitate civilian morale. A third possibility might have entailed the development of a pre-professional program in the training of military psychologists *per se*. While it is obvious that any one or all three of these latter possibilities could well play a functional role in the present emergency, existing conditions made it more imperative that the present course be designed specifically for potential army officers now in training. The acceptance of our objective in Psychology 50 appears all the more practicable by virtue of the fact that men eligible for enrollment are now engaged in the trainnig of beginning classes in the local Reserve Officer Training Corps. An opportunity is thus provided for the development of a course primarily practical and applied in nature. Problems, psychological in nature, encountered by these young men can thus be used in class discussions, and their solutions can serve as media for application in military training situations.

The arrangements necessary in the development of the course are enumerated below. First, the question of prerequisites for enrollment has been resolved by requiring this semester (1) enrollment in Advanced Military Science courses and (2) the successful completion of a beginning course in psychology.[4] Second, the course meets biweekly and each student receives two hours of credit toward graduation. The course does not, however, carry credit for majors in psychology. Third, the problems of instruction and staff-member participation have been solved as follows. The entire course is under the general supervision of the Co-ordinating Committee appointed by Professor Herbert Woodrow, Head of the Department of Psychology. Each subject-matter division of the course is conducted by a member or members of the department whose training and research are most closely related to the topics included in the outline which follows. Fourth, two one-hour examinations, composed of practical-situation questions, are

[4] The advisability of this second requirement is under consideration and study.

administered. These problems, of both a military and a psychological nature, are formulated by the staff members in charge of instruction. Fifth, in the absence of any suitable textbook in Military Psychology the students are referred to numerous references in applied psychology, military and psychological journals. These reference works are on reserve in a centrally located library reading room.

The content of the course in Military Psychology, as offered at the University of Illinois, is the result of cooperative, departmental action. This subject matter, briefly outlined below, is at present writing tentative and flexible in its final content. By this is meant that the content-outline is subject to revision and final evaluation. A forthcoming paper will provide a statement of context changes, if any, subsequent to this semester's presentation of the course. In the outline which follows attention is called to the fact that the name of the staff member in charge of preparing and presenting the material is listed. In certain instances two or more psychologists have collaborated. The number of class meetings allotted to each division is likewise indicated in the left marginal parenthesis.

Military Psychology (Psychology 50)[5]

A. Introduction to Military Psychology (L. A. Pennington)

(1) 1. Human engineering versus mechanical engineering.
2. The aim, content, and organization of the course.

B. The Psychology of Leadership and Discipline (W. G. McAllister)

1. Analysis of leadership situations with particular reference to officers and to the nature of followership.
2. Psychological approaches to leadership in military situations.

(4) 3. Psychological function of discipline; attainment and maintenance of discipline.
4. Psychological techniques in the maintenance of leadership; personal relations to men; inspiring confidence.
5. The training of men and the utilization of principles of learning and habit formation.

C. The Psychology of Morale (L. M. Hanks) and Group Motivation (P. T. Young)

1. Definition of morale and its determining factors in military situations.

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[5] The University of Illinois' *Catalogue* (1942–1943) describes Psychology 50 as follows: Applied psychological techniques serviceable to officers in army situations. Special emphasis is placed upon leadership, discipline, morale, efficiency, placement, and personality adjustment.

(7) 2. Causes and control of low morale.
3. How to attain and maintain high morale in army life.
4. The psychology of individual and group motivation in the army.

D. Psychological Factors Operative in Perceptual Problems of a Military Nature (H. B. Carlson)

1. Factors involved in the accuracy of observing at distances stationary and moving objects.
(4) 2. Accuracy of sound localization under different conditions.
3. Factors operative in judging the passage of time.
4. Normal errors in human observation and their recognition.

E. Psychological Forces Operative in the Efficiency of Military Personnel (J. T. Cowles)

1. Psychological effects of fatigue on mental and muscular work.
(4) 2. Procedures effective in the control of fatigue.
3. Environmental factors which limit efficiency; their recognition with suggestions for control.

F. Psychological Techniques Used in Military Placement (D. D. Feder and W. M. Gilbert)

1. Techniques useful in selecting the right man for the job.
(5) 2. The determination of effectiveness in placement.
3. How to interpret the results of psychological measuring instruments in general use.
4. Morale, discipline, and effective placement.

G. Personality Adjustment and Maladjustment in Military Life (L. A. Pennington and H. W. Case)

1. The nature and indicators of maladjustment in army life.
(3) 2. Useful remedial procedures in instances of maladjustment.
3. Applied techniques useful in maintenance of adequate adjustment to army life.

At this time it is quite clear that courses in Military Psychology *must* be oriented toward the applied rather than toward the more theoretical aspects of psychology. It is the belief of the members of the staff that this or a modified form of the present course may well possess marked practical value for the advanced ROTC student.

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THE ADJUTANT GENERAL'S SCHOOL AND THE TRAINING OF PSYCHOLOGICAL PERSONNEL FOR THE ARMY

BY MORTON A. SEIDENFELD
Major, A.G.D.[1]

One of the agencies of the war effort definitely interested in making use of large numbers of individuals with psychological training is The Adjutant General's Department. Few people who are not actually engaged with military affairs have any conception of the scope of activities, both administrative and operational, with which The Adjutant General's Department is charged. For example, a few of the functions that are normally required of this orgznization are: personnel activities including procurement, classification and assignment; the preparation and issuance of forms, regulations, manuals, and instructional matter; and the operation of the Army Postal Service.

To accomplish so many and such broad assignments, especially in view of an increase of more than ten-fold in the Army personnel, requires the carefully planned instruction of a very large and well trained group of officers and men. This created the responsibility of providing promptly a suitable training agency, properly equipped and with a specialized faculty.

To meet this need, The Adjutant General's School was formally established at Arlington Cantonment, Virginia, on June 14, 1941. The Commandant of the School, Colonel H. C. Holdridge, has been a prime factor in placing it upon a solid foundation. Highly energetic and untiring in his devotion to the principle of establishing a training center for this important work, he has made a significant contribution to the Army educational system. In addition, Colonel Holdridge has collected about him a splendid staff of officers and men who are devoted to the task of training men to carry on effectively the duties assigned them in The Adjutant General's Department.

Prior to the founding of The Adjutant General's School at Arlington Cantonment, instruction in the various technical phases of Army Administration had been given at the Army War College.

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[1] Very sincere thanks and appreciation is extended to Colonel H. C. Holdridge, Commandant of The Adjutant General's School, without whose help the historical portion of this article could not have been written.

The first course of instruction started on September 23, 1940, and was designed to prepare classification personnel for the reception and classification of the first group of Selective Service men. Subsequent courses continued at the Army War College until June, 1941, and covered general administration, operations of machine records (I.B.M. punch card personnel accounting), and classification of personnel.

The classes gradually increased in size. Approximately 200 students were assigned to each class during the time the school was established at Arlington Cantonment, Virginia.

In December, 1941, orders were received for the transfer of the school from Arlington Cantonment to Fort Washington, Maryland. Fort Washington was turned over to the school, effective January 1, 1942. It was essential that the post be completely rehabilitated to make it suitable for instructional purposes. This caused a delay in the commencement of instruction at the new location, the first course starting on February 2, 1942. At the present time (March, 1942) 1,469 have graduated from the school. Courses are held for a period of eight weeks each, with an intervening period of one week between courses. The number of officer students is now fixed at 300 per course.

Fort Washington is located on the Potomac River, sixteen miles from the District of Columbia. It occupies a naturally beautiful setting between the Potomac River and Piscataway Creek, opposite Mount Vernon. It is sufficiently isolated to encourage concentration on the instructional program, and yet sufficiently accessible to Washington, D. C., to facilitate maintaining close contact with the War Department and with other agencies interested in broad problems of administration. The Adjutant General's School constitutes the first agency established in the Army, charged with the development of administrative doctrines, organization, and procedures.

A new responsibility has recently been placed upon the school —the training of officer candidates. Two small groups, one of 25 and the other of 54, are well along in their courses of instruction. Increments of 120 men each will enter the school each six weeks. There is a prospect that this number may be increased to several hundred in the near future.

Instruction at the school is for both officers and officer candidates divided into four major phases: general administration, machine records, postal, and classification. Of these the course for

Classification Officers attracts a great many psychologists as well as officers whose civilian experience has been in the fields of employment management and vocational counselling. Enrollment in this particular course consists of 80 officers. The latter phase has just been expanded to include a group of personnel consultants.

The personnel consultant group is of particular interest to the profession, for it is in this category that all qualified psychologists entering the Army are placed. The well trained man with a Ph.D. or its equivalent in practical experience in clinical, industrial, or educational psychology is "earmarked" by appropriate classification at the time he is first interviewed shortly after his induction into the Army. Regardless of the classification process, however, a great deal of variation between the experience and training of individuals categorized as personnel consultants exists, and as a result it is highly important that a course of instruction dealing with the principles and practices of the Army psychological program be available. After experimentation with briefer courses, a new course eight weeks in length, was first initiated on March 30, 1942. Twenty-five personnel consultant officers, some of whom have had considerable military experience, as well as civilian practice, were enrolled. Among the important topics included in this course are:

Psychological Problems of the Army
Problems of Interviewing
Personnel Consultants and Assignment Problems
Use of Group Tests
Rating Scales
Clinical Procedures used by Personnel Consultants
The Individual Test Program of the Army
Marginal Intelligence and the Soldier
The Wechsler Mental Ability Scale, Army Form-B
Statistics and Statistical Interpretation
Abnormal Psychology in the Army
Cooperation of Psychologists and Psychiatrists
Analysis of Military Occupations

These topics and many others are supplemented by an extensive program of clinical demonstrations, field trips to Army installations where classification is carried on, clinical laboratory practice on Army personnel to train workers in proper techniques, and numerous seminars.

The faculty for this course is a highly distinguished one including both military and civilian personnel. Prominent among the civilian instructors are: G. C. Garrett, Walter V. Bingham, Marion

Richardson, C. S. Shartle, Harry Stack Sullivan, Winfred Overholser, Frederic Lyman Wells, and David Wechsler. The military faculty includes: Colonel Madison Pearson, Captain John Manning, Captain Donald Baier, Lt. T. W. Harrell, Lt. C. D. Leatherman, Major C. F. Hamilton, and Major M. A. Seidenfeld.

From this course Personnel Consultants are graduated and sent to duties in all types of Army installations, including work in the War Department as well as various types of field force units. Each will be well equipped to contribute his part to the total war effort of the Army.

PSYCHOLOGISTS IN GOVERNMENT SERVICE

BY DAEL WOLFLE

Emergency Committee of the National Research Council

Psychologists are interested in knowing which ones of their colleagues are actively engaged in services to their country. The following lists start to supply this information. Shortly before his death, John A. McGeoch, editor of THIS JOURNAL, Willard C. Olson, Secretary of the A.P.A., and I, as a representative of the Emergency Committee in Psychology of the N.R.C., arranged to send a post-card questionnaire to every member of the A.P.A. At the present time (May 7, 1942) 370 questionnaires have been returned. Of these, 228 were from psychologists giving full-time service, and 104 from psychologists giving part-time service to the federal government. An additional 38 cards were received from psychologists who seemed to be employed by state governments or working for private industry handling defense contracts. Neither of these groups is included in the following lists. Nor are psychologists who are not members of the A.P.A., or members of the A.P.A. who did not send in their post cards. The names of A.P.A. members who submit the requested information after the present date will be listed later.

Psychologists in a steady stream are leaving their present work for more direct participation in the war effort. In addition to the 332 names on the following list, a search through the 1942 A.P.A. yearbook and my own files adds 133 others. The known total is thus 465, or 14.4 per cent of the Members and Associates of the A.P.A. Of these, 324, or 10.0 per cent of the A.P.A. membership, are working full time for the U. S. government. This figure underestimates the actual situation to an unknown extent because my records are incomplete.

Some 30 to 40 branches and agencies of the government employ the 324 psychologists who are in full time service. The largest groups are included in table I. The duties performed by these psychologists include classification and selection of men for Army, Air Force, and Navy, testing and selection of applicants for civilian positions, research and construction of tests for selection of a wide variety of civilian and military specialists, administration of training programs for Army and Navy, clinical work with members of the armed forces, cryptographic analysis, analysis of foreign broad-

TABLE I

PRESENT DUTIES OF PSYCHOLOGISTS IN FULL TIME U. S. GOVERNMENT SERVICE

Branch of Government	*Number of Psychologists*
Social Security (including U. S. Employment Service)	61
Army (except for Air Force)	52
Army Air Force	48
Navy	38
Research for N.R.C. and N.D.R.C.	18
U. S. Public Health Service	18
Department of Agriculture	12
Civil Service Commission	12
U. S. Office of Education	7
National Youth Administration	7
Works Progress Administration	6
Office of Coordinator of Information	6
Federal Communications Commission	4
Miscellaneous	35

casts and of propaganda carried by other media, public opinion surveys, measurements of morale in this and other countries, confidential research in several psychological fields, and many others.

The present location of psychologists in full time work for the national government is shown in column 2 of table II. The heaviest concentration is naturally in Washington, D. C., but fairly large groups are working in a number of other places, notably Alabama, California, and Texas where the Army Air Corps has large installations. Except for these points of special concentration, the distribution of psychologists follows fairly closely the distribution of population throughout the country.

Column 3 of table II shows the state of residence of each of the 324 psychologists as given in the 1941 yearbook of the A.P.A. In some cases the 1940–1941 residence was estimated from degrees obtained at that time. The fourth column of the table gives the total number of psychologists in each state according to the 1941 A.P.A. yearbook, and the final column gives the percentage of each state's psychologists now working full time for the United States government. The percentages in this column were obtained

TABLE II

PRESENT LOCATION AND 1940–1941 RESIDENCE OF PSYCHOLOGISTS NOW WORKING FULL TIME FOR THE U. S. GOVERNMENT

State	*Number full time federal psychological employees now in each state*	*1940–1941 residence of psychologists now working full time for U. S. govt.*	*Total number psychologists in each state (tabulated from 1941 APA yearbook)*	*Percentage of psychologists from each state now working full time for U. S. government*
Alabama	12	2	18	11.1
Arizona	0	0	6	0
Arkansas	1	0	5	0
California	19	20	231	8.7
Colorado	1	1	30	3.3
Connecticut	2	13	86	15.1
Delaware	0	0	8	0.
District of Columbia	120	61	94	64.9
Florida	2	5	22	22.7
Georgia	5	2	14	14.3
Idaho	2	2	6	33.3
Illinois	16	26	237	11.0
Indiana	0	6	70	8.6
Iowa	0	8	65	12.3
Kansas	3	2	34	5.9
Kentucky	2	3	31	9.7
Louisiana	0	0	18	0
Maine	0	0	10	0
Maryland	6	7	45	15.6
Massachusetts	4	12	175	6.9
Michigan	5	6	107	5.6
Minnesota	7	10	101	9.9
Mississippi	1	0	10	0
Missouri	5	4	44	9.1
Montana	0	0	3	0
Nebraska	2	5	20	25.0
Nevada	0	0	1	0
New Hampshire	2	4	18	22.2
New Jersey	0	7	74	9.5

State	*Number full time federal psychological employees now in each state*	*1940–1941 residence of psychologists now working full time for U. S. govt.*	*Total number psychologists in each state (tabulated from 1941 APA yearbook)*	*Percentage of psychologists from each state now working full time for U. S. government*
New Mexico	0	1	5	20.0
New York	20	36	548	6.6
North Carolina	1	1	54	1.9
North Dakota	0	0	11	0
Ohio	11	17	198	8.6
Oklahoma	3	2	14	14.3
Oregon	3	4	22	18.2
Pennsylvania	12	16	228	7.0
Rhode Island	2	1	19	5.3
South Carolina	1	0	8	0
South Dakota	0	0	4	0
Tennessee	2	7	38	18.4
Texas	27	1	27	3.7
Utah	0	0	6	0
Vermont	0	1	12	8.3
Virginia	12	4	26	15.4
Washington	0	2	21	9.5
West Virginia	0	0	13	0
Wisconsin	1	4	42	9.5
Wyoming	0	0	5	0
Honolulu	1	1	10	10.0
*Canada	7	7	31	22.6*
England	1			
Unknown	4	14		
Total	324	324		

* In service of Canadian government.

by dividing the figures in column 3 by those in column 4. The percentages vary somewhat, but, with the understandable exception of Washington, D. C., are generally close enough to the national average of 10.0 per cent to justify the conclusion that each section of the country has contributed to the total group in proportion to the number of psychologists normally living in that section.

Incomplete as these data are, they show unmistakably that psychologists from all parts of the country are serving their country in many capacities. When peaceful times make it possible to tell the whole story of the psychological work now going on, that story will be one in which many psychologists will have participated and of which all may be proud.

LIST OF PSYCHOLOGISTS

*Indicates Part-Time

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SHERMAN, PFC. ARTHUR W., Classification Office, F.A.R.T.C., Fort Sill, Oklahoma, Psychological Tester.

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SLOAN, LOUISE L. Randolph Field, Texas, Ophthalmologist.

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*THORNE, FREDERICK C., Brandon State School, Brandon, Vermont, Neuropsychiatric Examiner, Army Induction Board, 3rd Recruiting District.

*TRABUE, M. R., Pennsylvania State College, State College, Pennsylvania, Member, Technical Committee, Occupational Analysis Section, U. S. Employment Service; Chairman, Subcommittee on Learning and Training, N.R.C. Emergency Committee in Psychology.

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UPHOFF, HOWARD FRANKLIN, Personnel Procedures Section, Adjutant General's Office, War Department, Washington, D. C., Personnel Technician.

VAN STEENBERG, NEIL J. F., 2145 "C" Street N. W., Washington, D. C., Assistant Director, Division of Youth Personnel, N.Y.A.

VEIGLE, EUGENE W., 438 Grant Street, Middletown, Pennsylvania, Research (pilot selection) for Army Air Corps.

VINACKE, W. EDGAR, 351 West 14th Street, Apt. 26, New York, New York, Project Technician.

WALKER, ROBERT Y., 405 Engr. Exp. Sta., Ohio State University, Columbus, Ohio, Supervisor, C.A.A.-N.R.C. Research in Pilot Training.

WALTON, CAPTAIN WILLIAM E., Research Section, Medical Division, Air Corps Replacement Training Center, Santa Ana, California, Research on selection.

WANTMAN, M. J., University of Rochester, Rochester, New York, Research, N.R.C. Committee on Selection and Training of Aircraft Pilots.

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WELTY, RUTH, Tudor Hall, Washington, D. C., Senior Assistant, Personnel Research, U. S. Civil Service Commission.

*WENDT, G. R., Wesleyan University, Middletown, Connecticut, Project Supervisor and Member, Executive Subcommittee, N.R.C., Committee on Selection and Training of Aircraft Pilots.

*WEVER, ERNEST GLEN, Princeton University, Princeton, New Jersey, Consultant N.D.R.C., Chairman, Subcommittee on Perceptual Problems, N.R.C.

WICKERSHAM, CAPTAIN FRANCIS M., Headquarters, Engineer Replacement Training Center, Fort Leonard Wood, Missouri, Personnel Consultant, Special Training Unit, designed to utilize mentally and physically deficient.

WILKINS, LT., (j.g.) WALTER L., 4403 30 Street, San Diego, California, Psychologist, U. S. Marine Corps Base, San Diego, California.

WILLIAMS, DAVID CARLTON, No. 1, Initial Training School, R.C.A.F., Toronto, Ontario, Canada, Research, Personnel Selection, National Research Council, Canada.

*WIMBERLY, STAN E., University of Florida, Gainesville, Florida, Consultant, Civilian Pilot Training Program, C.A.A.

*WINSOR, A. L., Cornell University, Ithaca, New York, Research, N.R.C. Committee on Selection and Training of Aircraft Pilots.

*WOLF, RALPH R., Jr., Yale University, New Haven, Connecticut, Industrial Psychologist, War Production Board.

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WULFECK, WALLACE H. Lock Drawer 6, Fort Monroe, Virginia, Research Associate, N.D.R.C., Princeton Field Laboratory, Fort Monroe, Virginia.

*YACORZYNSKI, G. K., Northwestern University Medical School, Chicago, Illinois, Research and Advisory.

*YERKES, ROBERT M., Yale School of Medicine, New Haven, Connecticut, Expert Consultant, Secretary of War, N.R.C. Emergency Committee in Psychology.

ZERGA, JOSEPH E., 1100 South Flower Street, Los Angeles, California, Occupational Analyst, U. S. Employment Service.

PSYCHOLOGISTS ENGAGED IN AVIATION CADET SELECTION AND CLASSIFICATION PROJECT IN THE OFFICE OF THE AIR SURGEON, ARMY AIR FORCES

Following is a list of psychologists on duty (as of April 15, 1942) in connection with the Aviation Cadet selection and classification project of the Office of the Air Surgeon, Army Air Forces. In addition to those listed below, more than fifty men with training in psychology are serving as enlisted men at various grades and classified as Psychological Assistants (Occupational Specialty 428) at each of the three Psychological Classification and Research Sections at Maxwell Field, Kelly Field, and Santa Ana.

PSYCHOLOGICAL DIVISION, OFFICE OF THE AIR SURGEON, HQS., ARMY AIR FORCES

LIEUT. COLONEL JOHN C. FLANAGAN, *Chief of Psychological Division*, from Cooperative Test Service of the American Council on Education.

MAJOR FRANK A. GELDARD, *Chief, Field Service and Liaison Section*, from the University of Virginia.

CAPTAIN WALTER L. DEEMER, *Chief, Statisticial Section*, from Harvard University.

CAPTAIN, JAMES J. GIBSON, *Chief, Perceptual Research Unit*, from Smith College.

1ST LT. PAUL M. FITTS, *Administrative Section*, from the University of Tennessee.

MRS. DOROTHY C. BECHTOLDT, from University of Chicago.

MR. CORLIN O. BEUM, from Statistical Department, State Government of Louisiana.

MR. WILLIAM J. CARNAHAN, from Personnel Research, U. S. Civil Service, Conm.

DR. LAUNOR F. CARTER, from Personnel Procedures Section, The Adjutant General's Office.

MR. JOHN T. DAILEY, from Texas University.

MR. FRANK J. DUDEK, from Brown University.

MR. CHESTER W. HARRIS, from Evaluation Staff, Progressive Education Association, University of Chicago.

MR. GEORGE B. SIMON, from Graduate Record Examination, Carnegie Foundation.

PSYCHOLOGICAL CLASSIFICATION AND RESEARCH SECTION, MAXWELL FIELD, ALABAMA

MAJOR LAURANCE F. SHAFFER, *Director*, from Carnegie Institute of Technology.

CAPTAIN FREDERIC WICKERT, from Coast Artillery Replacement Training Center, Fort Eustis, Virginia.

CAPTAIN LEWIS B. WARD, from State Teacher's College, Milwaukee, Wisconsin.

1ST. LT. NICHOLAS HOBBS, from the Citadel, Charleston, South Carolina.

1ST. LT. NEAL MILLER, from Yale University.

1ST. LT. DONALD E. SUPER, from Clark University.

1ST. LT. JOHN S. THATCHER, from the Adjutant General's School.

2ND. LT. FRANK H. BORING, from Windsor Locks Air Base, Connecticut.

1ST LT. JAY H. OSTWALT, from Baton Rouge Air Base, Baton Rouge, La.

PSYCHOLOGICAL CLASSIFICATION AND RESEARCH SECTION, KELLY FIELD, TEXAS

MAJOR ROBERT T. ROCK, *Director*, from Fordham University, New York.
CAPTAIN EDWIN E. GHISELLI, from University of California, Berkeley, Calif.
CAPTAIN WILLIAM M. LEPLEY, from Pennsylvania State College.
CAPTAIN, PHILIP H. DUBOIS from University of New Mexico.
1ST. LT. MEREDITH P. CRAWFORD, from Vanderbilt University.
1ST LT. RICHARD H. HENNEMAN, from the College of William and Mary.
1ST LT. GLENN W. HILDRETH, from Medical Administrative Corps.
1ST LT. ANTHONY C. TUCKER from Office of Education, Washington, D. C.
1ST LT. S. RAINS WALLACE, from Tulane University.
2ND LT. ALVIN J. KLEINSASSER, Yale University.

PSYCHOLOGICAL CLASSIFICATION AND RESEARCH SECTION, SANTA ANA, CALIFORNIA

MAJOR J. P. GUILFORD *Director*, from University of Southern California.
CAPTAIN MERRILL F. ROFF, from Indiana University.
CAPTAIN, WILLIAM E. WALTON, from University of Nebraska.
1ST. LT. CLARK W. CRANNELL, from University of Michigan.
1ST LT. ALBERT P. JOHNSON, from Purdue University.
1ST LT. EDWARD H. KEMP, from Duke University.
1ST LT. NEIL D. WARREN, from University of Southern California.
2ND LT. LLOYD G. HUMPHREYS, from Northwestern University.

PSYCHOLOGICAL DEPARTMENT, SCHOOL OF AVIATION MEDICINE, RANDOLPH FIELD, TEXAS

MAJOR ARTHUR W. MELTON, *Director*, from the University of Missouri.
1ST LT. JUDSON BROWN, from Yale University.
DR. JACK BUEL, from Wesleyan University, Middletown, Connecticut.
DR. WILBUR S. GREGORY, from University of Nebraska.
DR. ROGER, B. LOUCKS, from University of Washington.
DR. ROGER RUSSELL, from Michigan State College.

PSYCHOLOGISTS IN THE ARMED SERVICES

It may be of real interest to the psychological profession to know that of the many psychologists now in various branches of the armed services, practically all are engaged in (or in training for) duties of a psychological nature. Among the few exceptions are some psychologists whose preference it is to serve as leaders of combat troops.

TENTATIVE SUGGESTIONS ON UNDERGRADUATE PSYCHOLOGICAL TRAINING FOR WOMEN IN THE EMERGENCY

Questions have come from Psychology Departments of several women's colleges indicating a desire for suggestions for content of courses which may furnish useful training for the kinds of psychological services probably to be demanded of women by the present emergency.

In response to these inquiries, the SUBCOMMITTEE ON THE SERVICES OF WOMEN PSYCHOLOGISTS IN THE EMERGENCY (Subcommittee of the Emergency Committee in Psychology of the National Research Council) has requested DR. HELEN PEAK and DR. EDNA HEIDBREDER to prepare a summary of suggestions which the Subcommittee has assembled. Their report follows:

A list of areas in which training appears to be needed is offered at this time with two purposes in mind. First of all, it is possible that the information, though incomplete and tentative, will be of interest to Departments of Psychology which desire to point up their basic courses in ways which will make them of maximum value in the Emergency. More importantly, it is hoped that by publishing this outline comments and information will be elicited from readers with respect to the following points: 1) specific agencies (civilian or military) which are now known or are expected to require the services of women trained in psychology, 2) specific psychological skills that will be required in these services, 3) the desirability of the Subcommittee's sponsoring the preparation of bibliographies and outlines of course content that must be covered in preparation for skills that are in demand.

It should be emphasized that in presenting this outline there is no disposition to suggest that Departments of Psychology depart in any way from rigorous training in the fundamentals of Psychology as a science. It is only suggested that in the course of providing such fundamental training certain emphases may profitably be made and that these should bear a definite relation to Emergency needs. The lines of activity which seem to us to be most obviously important are enumerated below:

1. Child psychology. This might involve (a) training for those who plan to undertake the care of children in nursery schools, playgrounds, air raid shelters, etc., and/or (b) training for teachers of community courses for child-care volunteers. Much of the necessary material may simply be added to courses in Child Psychology already being given in colleges. Many organizations are interesting themselves in this type of training. Available material and procedures not only from the literature of psychology but also from the pamphlets and publications of various organizations now engaged in practical problems of child-care should be considered in the conduct of the course. If standards for such a course could be worked out with respect to lecture content and practical experience, it might be

possible to certify those trained in such courses, as the Red Cross now certifies those who have completed its courses.

2. Background courses in mental hygiene and psychiatry with special emphasis—and experience where possible—on the application of general principles (a) to rehabilitation of the wounded, and (b) to problems of civilian morale in a democracy.

3. Techniques of making and interpreting questionnaires to be used in various organizations sampling opinion, enlisting volunteers, etc.

4. Statistics and techniques of test construction.

5. Training courses in discussion and group leadership. A brief summary of material on leadership training has been prepared by Dr. T. Abel and Dr. A. Bryan and could be furnished upon request.

6. General courses in social psychology which shall include (a) material on principles and analysis of propaganda, (b) implications of psychological findings and principles for knowledge of general social and political processes, and (c) consideration of problems of morale in the light of all available material.

Please send all suggestions and criticisms to Dr. Edna Heidbreder, Wellesley College, or to Dr. Helen Peak, Randolph-Macon Woman's College.

Ruth S. Tolman, Chairman,
Subcommittee on Services of
Women Psychologists in the
Emergency.

NOTES ON SOME FEDERAL CIVIL SERVICE POSITIONS

A few facts about the opportunities for psychologists in civilian positions in the Federal service may be of interest to professional psychologists. Requisitions for personnel to fill a given position or series of positions are accompanied by a statement of the duties of the position. The statement of duties may embody or carry as an addendum a statement of the academic or professional background required. Whether or not the minimum qualifications are thus suggested, they are formulated and checked against the statement of duties before certification of persons on registers of eligibles or on the National Roster of Scientific and Specialized Personnel. The determination of who shall be certified for any given position is made on the basis of rank on a register of eligibles possessing the special qualifications desired, sex as requested by the appointing officer, and availability of services.

It is probably true that a small minority of psychologists in the Federal Government were recruited purely as psychologists. The demand for psychologists *as psychologists* has never been large. On the other hand, a total of approximately four hundred psychologists are employed in Washington in work more or less of a psychological character. In most types of positions in which they are employed in fairly large numbers, psychologists compete with neighboring disciplines. This fact will be evident from

the current list of types of positions for which there is current (April 15, 1942) need of qualified persons:

PUBLIC OPINION ANALYSTS—$2,000 to $5,600

DUTIES: Applicants will be required to analyze data as to the composition and function of organizations and groups in the United States whose activities might have general influence on public attitudes toward the war effort; to analyze press reports, radio broadcasts, speeches, motion pictures, etc.; to prepare or be responsible for the preparation of reports concerning public opinion and attitudes toward the war effort of the United States; to analyze data concerning grievances and prepare studies and reports on problems in various geographical areas as they relate to the need for information on particular subjects and the formulation or modification of information policy. The duties and responsibilities of the appointees will vary with the grade and policy of the positions to which they are assigned.

MINIMUM QUALIFICATIONS: Applicants must have had training and experience of a length and quality to insure familiarity with the field of public opinion and propaganda analysis. The amount and character of the training and experience required will vary with the grade and salary of the position for which the applicant is being considered. Applicants must have successfully completed a full 4-year course leading to a bachelor's degree in a college or university of recognized standing and should have done their major under-graduate or graduate work in one or more of the following fields: sociology, political science, social psychology, economics or international relations. Study in a combination of these fields is especially desirable as is also responsible professional research on the problems of the adjustment of minority groups to their environment, the analysis of material as to its propaganda content, the effects of industrial changes on public opinion, etc.

LOCATION OF POSITIONS: Most of these positions are in Washington, D. C.; only a few are in the field.

SALARIES: Most of the positions will pay from $2,000 to $3,800; a limited number will be filled at $4,600 and $5,600.

PERSONNEL TECHNICIANS (Tests and Measurements)—$1,800 to $3,200

Persons with merit system or other civil service experience are especially desired. Those with actual experience in construction of aptitude tests upon the basis of job analyses have a great advantage over those persons with only educational testing experience.

JOB ANALYSTS—$1,800 to $2,600

Men with actual experience in job analysis in industry are in demand.

For all types of positions listed above, applications should be made to the Education and Psychology Unit, U. S. Civil Service Commission, Washington, D. C. (Applications should *not* be sent to the Office of Psychological Personnel.)

There is little or no demand for clinical psychologists, teachers of psychology, guidance counselors. However, some psychologists with engineering or industrial training and experience may be encouraged to apply for Training Specialist and to make sure that their records with the National Roster of Scientific and Specialized Personnel are complete with respect to their suitability for and availability for such positions. There has been a moderate demand for experimental psychologists, usually in some

small area; this demand has been well met by the National Roster. Several psychologists have been employed as statisticians; qualified persons are urged to apply for such positions. A current recruiting circular from the U. S. Civil Service Commission has a full statement of minimum qualifications.

CHILDREN'S REACTION TO WAR

The ten psychologists associated with the Minnesota Bureau for Psychological Services have offered, as a volunteer war-time service, to speak to lay groups throughout the State on "Children's Reaction to War." The ten psychologists are: Helen Webster Brasie, Dora Capwell, Stuart W. Cook, Louise W. Gates, William Mansfield Hales, Mildred Mitchell, Maurice Odoroff, Luella Pesek, Carl Swedenburg, J. Lewis Yager.

Their talks will be available to parent-teacher organizations, or any similar bodies. Since some of the psychologists in the group are stationed at institutions throughout the State, and others travel from one county to another, an opportunity to hear these discussions will be provided for small communities, as well as metropolitan areas. For some time a great need has been felt for such a program. In addition, Minnesota has been mentioned as a potential reception center for evacuated children, and discussion at this time of children's wartime reactions should have great potential value as preparation for the problems to be encountered should evacuation to this area take place. The talks which are given cover such subjects as the following:

Children's fears and anxieties; rebellious, aggressive, and delinquent behavior; "nervous" habits, sleep disturbances, and personality problems.

The effect of war conditions, overtime employment, and parental anxiety in giving rise to these childhood problems or in exaggerating them.

How to modify these reactions of children to the war.

How to avoid the development of a hatred of all children of German, Italian, and Oriental origin (with a discussion of the danger of possible "scapegoat" situations).

How to explain the war to children in such a way as not to conflict with other training they receive.

How to take advantage of the war situation to improve the training of children.

COUNCIL ON HUMAN RELATIONS

THE COUNCIL ON HUMAN RELATIONS, 15 West 77th Street, New York City, has recently been established, with DR. GREGORY BATESON as Secretary. The Council is devoted to the study of all those cultural factors—institutions, habits, and character—which, differing profoundly from one nation to another, are relevant to international cooperation.

The Council on Human Relations is interested in furthering collaboration among all students of personality and culture whose collecter ma-

terials, current researches, and projects of research may be useful for a scientific approach to problems of international relations. In particular, the Council is interested in the immediate problems of cooperation among the allied nations and the future problems of world reorganization, when the cooperation of all nations will be necessary.

The Council hopes to serve as a clearing house for research in this broad field, by putting those who are interested in working on the same culture in touch with each other, and those who are working with comparable techniques, but on different cultures, in touch with each other. The Council also proposes to circulate among its collaborators abstracts and bibliographies on these subjects.

CONFERENCE HELD BY THE OFFICE OF PSYCHOLOGICAL PERSONNEL

Over fifty psychologists and employers of psychologists from the various Federal agencies listed in the April issue of the *Psychological Bulletin* attended a conference held by the Executive Director of the Office of Psychological Personnel at the National Research Council on April 23. The ways in which the newly created Office of Psychological Personnel could be of service to psychologists and other officials in various Government agencies was discussed; and it was agreed that the Office could be of assistance on certain personnel matters, and also in connection with proposed research projects.

ADDITIONAL FEDERAL AGENCIES

To the list of Federal agencies listed in the April issue as employers of psychologists should be added the names of the Division of Mental Hygiene of the United States Public Health Service, the Office of Price Administration, the War Production Board, the Federal Bureau of Investigation, and the Board of Economic Warfare.

AFFILIATION WITH THE AMERICAN PSYCHOLOGICAL ASSOCIATION

It may be of interest to psychologists to learn that the Secretary of the American Psychological Association has received a number of requests from members and associates of the American Psychological Association to write a letter certifying to their affiliation with the Association. This has been done in connection with various applications relating to the armed services. The professional status of a psychologist is considered important in various situations.

BOOK REVIEWS

McNEMAR, Q., & MERRILL, M. A. (Eds.) Studies in personality, contributed in honor of Lewis M. Terman. New York: McGraw-Hill, 1942. Pp. x+333.

Former students and associates of Professor Terman offer here some seventeen chapters representing a wide range of interests and activities. The introductory chapter by Robert S. Woodworth is itself a graceful and spirited achievement in the field of biography. His appreciation of Terman's work and position in psychology will be heartily endorsed by us all.

The first of the studies in child psychology is an experimental research by Roger G. Barker on the "Resolution of Conflict by Children." Seven liquids were used as preference materials, and children made various choices as to which they would drink. Their behavior was recorded instrumentally. It was found, among other things, that vacillating behavior was more marked when choice lay between items close together in the preference series. Also, preference was more tardy when selection was between unpleasant drinks than when it was between pleasant ones. The best drink offered was orange juice, and the worst was salt water.

Barbara S. Burks presents a painstaking study of a pair of twin girls, probably identical twins, reared apart under differing types of family relationships. Numerous mental and physical tests and ratings were used. Many similarities and some differences appear.

Franklin Fearing writes on "The Appraisal Interview: A Critical Consideration of Its Theory and Practice With Particular Reference to the Selection of Public Personnel," and Florence Goodenough, on "The Use of Free Association in the Objective Measurement of Personality." H. F. Harlow, studying the responses of rhesus monkeys, concludes that these animals are capable "of solving problems of greater complexity than has heretofore been demonstrated." L. P. Herrington studies "The Relation of Physiological and Social Indices of Activity Level." E. Lowell Kelly inquires whether there is any relationship between the rated personality traits of men and women and the nature and source of their early sex instruction. He concludes negatively. In the field of "Psychical Belief," a paper by John L. Kennedy submits a comparison between answers to a questionnaire given twenty-five years ago to Stanford students and again to a present-day group. There appears a notable decline in belief in psychical phenomena.

A very scholarly and significant paper is Chapter X, by Heinrich Klüver, on "Mechanisms of Hallucinations." The author organizes a large number of observations in this elusive and difficult field. He asks whether there are "any hallucinatory constants." Speaking on the basis of his own analysis of hallucinatory phenomena appearing chiefly during the first stages of mescaline intoxication, the author states that these phenomena "yielded the following *form constants:* (a) grating, lattice, fretwork, filigree, honeycomb, or chessboard; (b) cobweb; (c) tunnel, funnel, alley, cone, or vessel; (d) spiral. Many phenomena are, on close examination, nothing but modifications and transformations of these basic

forms. The tendency toward 'geometrization,' as expressed in these form constants, is also apparent in the following two ways: (a) the forms are frequently repeated, combined, or elaborated into ornamental designs and mosaics of various kinds; (b) the elements constituting these forms, such as the squares in a chessboard design, often have boundaries consisting of geometric forms." Similar forms have been reported in cases of other types of hallucination, and their possible dependence on visual structures is suggested. The present notice is in no sense an adequate indication of the materials treated in Professor Klüver's paper.

Among the remaining studies are those of C. C. Miles, Floyd L. Ruch, Robert R. Sears, and Miles A. Tinker, with a brief note by Raymond R. Willoughby. The reviewer feels that Chapter XIV is especially worthy of comment and study. This is by Eugene Shen, on "The Place of Individual Differences in Experimentation."

The final chapter is by Kimball Young, on "Variations in Personality Manifestations in Mormon Polygynous Families." Case histories of Mormon families are discussed with reference to the emotional and other adjustments within the family. It is pointed out that these families did not live in a community where complete polygyny obtained; for "In Mormondom, as in other Societies permitting plural wifehood, the basic pattern remained monogamous. Although no adequate figures are available, probably not more than 10 per cent of Mormon families fell into the plural-marriage class in the period of its greatest frequency—approximately 1870–1880." Hence the practice of plural marriage was the occasion of conflict, because the legal and moral pressure of the larger community in which the Mormon lived was at variance with the recommendations of his church. The author finds that there is a wide range in the effective adaptations. "In a large number there is full faith in plural wifehood. It is well accepted, at least at the conscious level. In others, there is more overt resentment, exemplified in the struggle for status, in jealousy and envy," etc. The whole paper is informing and valuable.

Professor Terman and the contributors to this volume are all to be congratulated on the performance.

K. GORDON.

University of California at Los Angeles.

HORST, P. The prediction of personal adjustment. New York: Social Science Research Council, 1941. Pp. xii + 455.

This monograph is divided into two quite distinct parts. In Part I is presented a systematic discussion of the nature of prediction and the factors influencing its efficiency. The psychologist with some advanced training in statistics will find this part relatively easy reading. Part II consists of a number of supplementary studies, several of which make new contributions to the theory and practice of prediction. With the exception of the section on the case study method, this part will not be readily understood by the typical psychologist. The present review is limited largely to the material found in Part I, the main body of the text.

In his discussion of the theory and techniques of prediction the author has made several important contributions to the understanding of the

prediction problem. Most of the specific points mentioned are not new, but, presented in organized form for the first time, they are likely to affect beneficially the practical application of prediction techniques. The first, and one of the most important, of these contributions is the thorough discussion of the problem of the criterion. Attention is drawn to the fact that success is usually made up of a number of factors and that these factors must be identified, measured, and properly combined. For some problems a multiple criterion is essential while for others a single criterion may be adequate. Furthermore, success can be measured in terms of satisfaction of the person engaging in the activity or in terms of independent standards, or both. Regardless of the nature or type of criterion used, it must be stable and it must lend itself to quantitative appraisal. It is quite evident that many criteria for measuring educational and vocational success do not meet these standards.

A second contribution is concerned with the importance of the temporal relationship of the predictive factors to the criterion factors. The author emphasizes that it should be possible to assess the factors on which prediction is based before the individual engages in the activity. As stated, the principle sounds simple, but its operation is subtle, as shown by the fact that it has not been recognized by many investigators. In studies which have been made of successful and unsuccessful employees it has often been assumed that the differentiating characteristics could be regarded as factors causally related to success and that, if identified and measured earlier, they could be used in the prediction equation. The truth of the matter is that these differentiating characteristics may be purely the result of the work experience rather than the cause of it. Under such circumstances corrections for experience must be made.

The discussion of linear and nonlinear relationships constitutes a third important contribution. Most prediction studies have proceeded on the assumption that the variables should be combined in a linear manner in order to predict the criterion. The assumption underlying this practice is that the weight to be assigned to any of the variables being combined should be the same for all values of the variable and that this weight should not vary with variations of scores on the other predictive variables in the system. For example, intelligence and motivation may both be important variables in the prediction of vocational success, but it may make some difference whether one is working with superior or inferior individuals as to the values which should be assigned these variables. In many prediction problems it appears that the weight to be assigned each variable is not a constant but rather a function of all the variables in the system.

Pointing out that most prediction studies end without ever attempting to predict is a fourth significant contribution. Many investigators have reported studies in which a regression equation has been set up for an original group but never tried out on a similar group using the weights from the first equation. If the number of variables is large, there is a tendency for the accuracy of prediction to decrease whenever the weights obtained for the first sample are applied to a second group. In Part II there is given for the first time a mathematical analysis of the drop in predictability in subsequent samples.

The chapter on research suggestions contains a number of important contributions. One of the most interesting of these is the proposal that coöperative research studies be instituted. The author points out that the development of a more accurate and complete science of prediction of personal adjustment requires that studies be made of large numbers of people in various life activities. In the field of vocational prediction close collaboration between schools and colleges and employing organizations would be especially desirable. Recent developments in the field of statistics have made such coöperative projects entirely feasible.

Perhaps the chief contribution made by the publication of this volume is the pointing out of the fact that our techniques of prediction are quite inadequate. Large numbers of studies have been made, but they do not follow a systematic plan. There is a real need at the present time for someone to summarize what we know in each area of prediction and to suggest what the next steps should be. In a sense, this volume does point the way in which research energies should be directed, but most of the topics are treated briefly. The chapter on research suggestions is especially disappointing in this respect. The only subject which is treated in a very complete manner is the case study method. Anyone interested in making predictions from case studies will find this treatment worthy of his careful study.

In reading this book one cannot help but sense the implication that progress in the prediction of personal adjustment will be very slow as long as nonmathematically-trained people continue to dominate (in numbers) the field. Without thorough training in mathematics an individual could hardly hope to solve some of the problems outlined. Perhaps the day is past when the nonmathematically-minded student could turn to the social sciences for escape from quantitative thinking. At least for those who go on to the Ph.D. degree in psychology it would seem that some training in college mathematics would be highly desirable. For the more intricate prediction problems teams of psychologists, sociologists, economists, and mathematicians would be in the best position to carry on the necessary research studies.

The illustrations used in the monograph are limited to those involving predictions of success in educational and vocational adjustment, marriage, and law observance, but the methods discussed would be equally applicable to other activities in which a criterion can be established. While the list of references is small, it was carefully selected. The presentation of the material, both new and old, is scholarly. One can only regret that more space was not available for most of the topics.

DEWEY B. STUIT.

University of Iowa.

RUCH, F. L., MACKENZIE, G. N., & MCCLEAN, M. People are important. Chicago: Scott, Foresman, 1941. Pp. xii + 283.

This book is an addition to a very small group of psychology texts that can be seriously considered for use in high school. The authors state that it "provides materials which will aid high-school boys and girls in their considerations of personal and personal-social problems." The em-

phasis is such that one would not be greatly in error to designate it as a text in applied high school social psychology. Those who look for special treatment of topics such as physiological background, functions of sense organs, perception, testing, and applications to specific fields of industry, children, and education will be disappointed. There is no broad survey of the many applications of modern psychology. A unit on romance and marriage is an interesting deviation from the traditional material.

There are three major divisions in the book: Part I, "You"; Part II, "You and Your Activities"; and Part III, "You and Others." Each of these parts is further divided into "units." (By some delicate distinction in modern education, when materials become functional and are given the problem treatment, they become "units" instead of chapters!) In Part I the units are: "Meet the People—and Find Yourself"; "Things That Make You Go—and Stop"; "Controlling Your Emotions"; and "Learning to Think Straight." In Part II the units are: "Getting at the Truth"; "Choosing Your Life Work"; and "Planning Your Playtime." Part III contains the units: "Growing Up"; "The Age of Romance"; and "Getting Along With Others."

Numerous questions are addressed directly to the student in an attempt to get the adolescent to consider his own problems in adjustment. The authors intend that these should serve as the basis for class discussions. However, the questions occur with such frequency and sometimes so many in a series, one right after another, that the reading becomes a bit monotonous. One wonders whether or not somewhat fewer questions and more expository material would have been an improvement. It will be interesting to note whether high school students give this reaction. There is a further objection that, unless teachers in secondary school are better grounded in psychology than they are at the present time, discussions will result merely in an exchange of preconceived notions. While it is certainly desirable that each person become clearly aware of his problems—and no one would deny that discussion is a stimulation to thinking—yet it would be unfortunate to foster the "every man his own psychologist" attitude. Is it not possible that today in education too much faith is being placed in discussion as a method of uncovering profound wisdom?

The book is given a modern streamlined appearance by the use of a number of pictures with "bleeder edges."

For those who wish to emphasize the social aspect of our activities, this is probably the best text for high schools available at the present time.

MARTIN F. FRITZ.

Iowa State College.

ROBINSON, F. P. Diagnostic and remedial techniques for effective study. New York: Harper, 1941. Pp. ix+318.

This book deals with the diagnosis and correction of factors which may adversely affect the academic achievement of college students. It is primarily a workbook, but it contains so much discussion of the topics covered that no supplementary textbook need be used with it. It is to be used by the student in diagnosing and correcting his own weaknesses; it

is not a textbook for use in courses designed to prepare specialists in remedial reading and study. However, as the author states, "it is not a book that can be read by a student without aid; a trained counsellor must provide the necessary individual interpretations and recommendations."

One of the strong points of the book is the range of factors related to academic achievement which it contains. Part I deals with "Study Skills, Fundamental Processes, and Background Information"—factors related directly to achievement. It includes eight projects (chapters): I, "Introduction"; II, "Concentration and the Use of Time"; III, "Reading Ability: Rate, Vocabulary, Comprehension, Special Reading Skills (graphs, tables, etc.), Use of the Dictionary"; IV, "How to Organize and Take Notes"; V, "Academic Skills: Use of the Library, Writing Term Papers, Taking Examinations"; VI, "Writing Skills: Grammar, Spelling, Handwriting"; VII, "Mathematics"; VIII, "Memory."

Part II deals with "Problem Areas Indirectly Affecting Effective Study" and includes seven projects: IX, "Health and Health Habits"; X, "Motivation"; XI, "Vocational Orientation"; XII, "Recreational Orientation"; XIII, "Social Adjustment"; XIV, "Personal Problems"; XV, "Looking Ahead" (a general summary of progress made and problems remaining). These topics are analyzed only in so far as they relate to academic achievement, not as problems of general personal adjustment.

The majority of projects contain three types of material: (1) discussion of the effect on academic achievement of the factor analyzed; (2) diagnostic tests which the student can administer and score for himself; (3) recommendations for remedying deficiencies revealed by the tests.

The diagnostic tests make the book a distinct contribution as a workbook for remedial classes in study methods, for they cover an unusually wide range of factors. Approximately 66% of the pages are occupied by these tests and scoring keys. This emphasis is justified by the fact that the possibility for successful correction of any deficiency depends upon the accuracy and thoroughness of the diagnosis. Although inclusion in the book of the scoring keys for the tests has obvious disadvantages it permits the student to score his own tests, a procedure which may give him better insight into his deficiencies and may motivate him to correct them through self-discovery of the deficiencies. Incidentally, the procedure will save time for the instructor.

The majority of proposals for the correction of deficiencies are presented in the form of suggestions rather than in the form of practice laboratory exercises. This may prove to be the major weakness of the book, for many of the "poor students" who use the book will find the suggestions too indefinite to be able to apply them. However, the competent counsellor should be able to supplement the book with any necessary detailed instructions or projects for the student. The author apparently chose this form of presentation of remedial suggestions, in spite of its limitations, because it permits greater freedom in adapting remedial projects to the needs of the particular individual.

WILBUR S. GREGORY.

University of Nebraska.

FREEMAN, W., & WATTS, J. W. Psychosurgery: intelligence, emotion and social behavior following prefrontal lobotomy for mental disorders. (With special psychometric and personality profile studies by T. Hunt.) Springfield, Ill.: Thomas, 1942. Pp. xii + 337.

"Lobotomy" consists of an incision in the frontal lobe intended to cut most of the fiber connections between the frontal association areas and the rest of the brain; it is different from "lobectomy," since the frontal pole is not completely severed or removed. Freeman and Watts give the result of treating seventy-seven cases of mental illness by this surgical method. The book is introduced by an extensive review of earlier studies of the frontal lobe (with a bibliography of 320 titles) and concludes with a new theory of frontal lobe function.

The deliberate destruction of brain tissue, and in a way likely to produce scar tissue and possible epilepsy, demands justification. The reviewer must admit to an initial prejudice against the procedure, which makes his favorable impression from this book more important. The statistics on improvement following operation are remarkably good. There is a large majority of cases in which both patients and relatives are described as pleased with the results. In seventy-seven cases there were three deaths due to operation (all three patients were sixty years of age or older) and three cases in which fits continued. On the other hand, the frequency of fits may increase with time, and there has not been an adequate number of electroencephalograms done as a preliminary check on this. The small number of EEG's (only one in a patient of Freeman and Watts, and two in other patients) is not enough to justify the assertion that lobotomy leaves the EEG undisturbed, especially since the "baseline oscillation" in their own case does not look like a good sign (p. 184). But one might have expected more radical disturbances, and the reports cited are favorable rather than not.

The following statistics, among others, are given on the effect of operation: in cases of depression, 26 "good," 9 "fair," and 3 "poor" (these terms are not clearly defined, but the authors do not appear to minimize unsatisfactory results); in schizophrenia, 5 good, 4 fair, and 2 poor; and in obsessive conditions, 14 good, 1 fair, and 2 poor. These are very good statistics. Since the procedure seems to have more value for some kinds of illness than for others, the number of satisfactory cases in the total group (63%) does not wholly show the value of the surgical treatment. There are, of course, still grounds for caution, as the authors point out. Some patients recover spontaneously, so recoveries in a single series of cases are not conclusive; and the procedure is still to be tested by time (it was first done by Moniz in 1935, by the authors in 1936). The disappointing history of shock therapy, of which surgical treatment may merely be another form, is a warning against overoptimistic first reports, but optimism by the authors at least seems quite justified.

The attempt to find theoretical justification for the procedure is perhaps not as good. The authors emphasize that Moniz based the method originally on theoretical considerations, and they attempt a theoretical synthesis of their own results and those from a large number of experimental and clinical studies:

The cerebral cortex may be considered as being divided by the Rolandic fissure into two portions of essentially different function. The parts posterior . . . are concerned with the reception of impulses . . . and with the elaboration of these impulses into engrams. . . . The individual is brought by the post-Rolandic cortex into relation with all that has gone before in his existence. Experience and intelligence, the bases of his behavior, are mediated by this part of the brain.

Just as the post-Rolandic cortex is concerned with the past, the pre-Rolandic cortex is concerned with the future. . . . With the intact brain the individual is able to foresee . . . the results of certain activities that he is to initiate in the future, and he can visualize what effect these actions will have upon himself and upon his environment.

The authors state their theory modestly, and the reader will find it useful or fantastic, according to his own ideas. To the reviewer it seems that this is another of the clinical generalizations concerning behavior that come somewhere near the mark and that are yet open to insuperable difficulties as theoretical formulations. Facts reported by the authors do not seem wholly to support their theory. Why, for example, should patients become better adjusted socially if the frontal lobe lesion produces "an apparent inability to foresee accurately the results of planned acts *as they relate to the individual himself*" (authors' italics)? And why, if the frontal lobe deals with the future, should *remorse* and *guilt* disappear? The conclusion that the frontal lobes have nothing to do with intelligence also seems to go far beyond any existing evidence.

The intelligence-test data reported here by Hunt are, in part, the basis for the idea that frontal lobe lesions do not affect intelligence, and they are certainly not adequate to any such conclusion. The opportunity in these cases to get data, for the first time, on the effect of experimentally controllable frontal lobe lesions in the human brain, without any gross pathological lesion before operation, was of almost incalculable value, but Hunt does take advantage of it. Other investigators have had to guess at the intelligence of the patient before brain damage occurred. The value of checking on these earlier conclusions should have been obvious, but few of the tests used by other investigators have been used here. Hunt complains that little time was available for examination, and there, of course, is always difficulty in getting coöperation in such circumstances, but there must have been more time (and coöperation) in some cases. A more elaborate study even in a few cases would have been thoroughly worth while. Moreover, some of the tests used (cancellation, substitution, color-naming) appear almost worthless as measures of intelligence. The results are reported in a most unsatisfactory way, and no statistical data are given for two tests devised for this study. The coins-under-cup test should make a valuable liaison with Jacobsen's studies of frontal lobe injury in apes, and the match-stick test a useful quantification of one of Goldstein's tests, but no information is given from which their value as quantitative measures can be judged. Finally, the total results are given in a table (p. 158) reporting, for each test, per cent of subjects doing *better*, *same*, or *worse* after operation—without a single score, average, or deviation value—and a simple statement that the differences were or were not reliable. No convincing evidence is given that the apparently

satisfactory postoperative scores do not involve practice effect. For what they are, the data indicate a postoperative improvement in a number of measures, and no loss in any.

The reviewer is not competent to discuss the details of Rorschach results, but they are described as paralleling the clinical improvement. On the whole, the psychometric data of this study are of considerable interest, and it may be hoped that more detailed report of results, and with other tests, may be given in the future.

This book is definitely of a much greater scientific significance than would be suggested by its meretricious title and a jacket blurb that promises to show "how personality can be cut to measure."

D. O. HEBB.

Queen's University.

HAYES, S. P. Contributions to a psychology of blindness. New York: American Foundation for the Blind, 1941. Pp. viii + 296.

This book is written by the outstanding American expert on the psychology of the blind. For the past twenty-five years Hayes has been engaged in psychological research dealing with the blind. The reports of this work have been published from time to time in many different journals, in association publications, and in separate pamphlets. Some of these publications are rarely read by psychologists, and some of the pamphlets were not easily obtainable by students. Now all of this valuable work has been gathered together in the present volume.

In addition to this, our author has dealt with the work of other psychologists in this area. He has surveyed the researches of the German, French, and American psychologists with reference to those problems which first attracted the attention of psychology, namely: sensory compensation, facial vision, and memory. He has modestly called his book *Contributions to a psychology of blindness*, when he might readily have omitted the "Contributions" and boldly called it a "Psychology of Blindness," because it is undoubtedly the most complete psychology of blindness in the English language up to this time.

The book is divided into two parts. The first deals with the classical problems of sensory compensation, facial vision, and memory, as well as with the newer problem of the intelligence of the blind. In these chapters the author gives a good account of the previous work in these fields as well as his own contributions. He shows how the myth of sensory compensation has survived for a long time, in spite of much evidence against it. The blind do not possess greater acuity in audition or touch or smell than do the sighted. They do not possess the ability to feel colors, nor do they have greater talent in music than the seeing. There is no compensation for their loss of vision. They must train the other senses to take the place of the visual sense as far as possible. The chapter on facial vision or the sense of obstacles, the so-called "sixth sense" of the blind, presents the research work in this field, discusses the various hypotheses proposed, and shows that this problem is not yet fully settled. The relation of intelligence to the amount of vision possessed brings out the fact

that, among the children in our schools for the blind, intelligence tends to decrease as vision increases. This is a matter of pupil selection. The duller pupils with slight visual defects tend to gravitate to schools for the blind; the brighter ones tend to remain in the normal public schools.

The second part of the book is devoted to mental measurement in schools for the blind, and this part is almost entirely the original work of Hayes himself. It gives the results of testing over 2000 cases with the Hayes-Binet scale. It also summarizes a great amount of work with many standard educational achievement tests which have been adapted for use in schools for the blind. There are chapters here that will be invaluable for teachers of the blind who are doing their own educational achievement testing. A list of tests suitable for the blind, either in braille or to be used orally, shows the wide scope of Hayes' work and will prove useful for the psychologist or teacher working with the blind.

Throughout the book there are good suggestions for further research work in this area. Adequate bibliographies follow each chapter. This book is indispensable for all workers with the blind and for all school or clinical psychologists who may come in contact with blind children in the course of their work.

R. PINTNER.

Teachers College, Columbia University.

LINDQUIST, E. F. A first course in statistics. (Revised ed.) Boston: Houghton Mifflin, 1942. Text: Pp. vii + 242; study manual: Pp. 117.

If a revision and extension of one chapter, plus the changing of four pages in another chapter, constitute the revision of a book, then and only then can this be called a revision of the author's 1938 work (reviewed in the *Bulletin*, 1938, **35**, 318–320). One wonders whether this irritating habit of publishers results in sufficient sales to offset the ill will engendered.

We hasten to say that the revised chapter, although adding nothing which wasn't known when the first edition was published, is by far the best chapter on sampling to be found in the elementary texts. The additions include more on sampling distributions, the concept of confidence interval, levels of confidence, the exact and the null hypotheses, small-sample techniques, and a table of t. The reviewer still believes that a discussion of the elementary notions of probability would strengthen this text, which is essentially sound and has already demonstrated its usefulness.

QUINN MCNEMAR.

Social Science Research Council.

NOTES AND NEWS

At the Nashville meeting of the Southern Society for Philosophy and Psychology April 2–4, the following officers were elected: President, Dr. Christian Paul Heinlein of Florida State College for Women; Secretary-Treasurer, Dr. Wayne Dennis of the Louisiana State University; Members of the Council, Dr. Elizabeth Duffy of the Woman's College of the University of North Carolina, Dr. S. Rains Wallace of Tulane University, and Dr. Peter A. Carmichael of Louisiana State University. Next year's meeting will be held in Chattanooga.

Professor Gordon Allport, Harvard University, was elected president of the Eastern Psychological Association, at its recent meeting at Brown University. Other officers elected were: Dr. Theodora M. Abel, Thiells, N. Y., Secretary; Dr. Kurt Goldstein, Tufts Medical School, Member of the Program Committee; and Professor Gardner Murphy, College of the City of New York, and Dr. Otto Klineberg, Columbia University, Directors.

The American Society for Aesthetics moved toward more definite organization at a meeting in Washington, D. C., April 23rd, through 25th. Thomas Munro of the Cleveland Museum of Art was elected president; Max Schoen of the Carnegie Institute of Technology, treasurer; Ralph B. Winn of the College of the City of New York, secretary. Persons interested in becoming members should write to Dr. Munro, stating their qualifications in the way of degrees or academic connections and publications or artistic achievements. Membership will be restricted to those of professional standing or other indications of mature ability and serious interest in aesthetics and related fields. The Society's object is to encourage research, writing, discussion, and publication. Its membership includes persons interested in various arts as well as philosophers and psychologists.

Columbia University announces the retirement, effective June 30, of Dr. Robert S. Woodworth, Professor of Psychology.

Dr. Walter B. Cannon, George Higginson professor of Physiology at Harvard University, will retire with the title emeritus on September 1.

Dr. B. Frederic Skinner, associate professor of Psychology, University of Minnesota, has been awarded a Guggenheim fellowship for the year 1942–43, in order to complete a study of the psychology of language on which he has been at work for several years.

Promotions recently announced are: Dr. Fred S. Keller, to an assistant Professorship of Psychology at Columbia University, and Dr. Claude C. Neet to a professorship of Psychology as Massachusetts State College. Dr. M. O. Wilson has been appointed chairman of the Department of Psychology of the University of Oklahoma.

The American Society for Psychical Research announces that the Hyslop-Prince Fellowship for the year 1942–43 is awarded to Dr. Ernest Taves.

SPECIAL NOTICE

Hereafter all manuscripts, books for review, and correspondence concerning the PSYCHOLOGICAL BULLETIN should be sent to the new editor, Professor John E. Anderson, Institute of Child Welfare, University of Minnesota, Minneapolis, Minnesota.